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RESEARCH WORKERS.

Training for Estates in the Tropics.

THE need for more research into the agricultural problems of the Tropics has been urged for many years but the necessity has only been more generally appreciated since the termination of the war. The greatly increased demand for the raw products of the Tropics has naturally attracted capital and numerous companies, syndicates and corporations have been organised to meet the needs of the situation. Most of these plantations have been founded to meet the growing demand of the markets in accordance with the usual law of supply and demand. In many cases, a particular industry has had the need for research forced upon it owing to some circumstance such as the damage done by pests or diseases. Generally speaking, however, it is competition that has compelled the owners to seek means whereby they can lower their costs of production and this has meant that they have had to seek more up-to-date methods. In most well organised agricultural industries the time has gone when increased cost of production can be met to any great extent by drastic cuts in the labour and overhead charges. Rather is the tendency to accept the fact that the price of labour is everywhere steadily on the upgrade and to counteract this tendency by exploring the possibilities of increasing the yield per acre of the particular crops cultivated on a plantation. Much has been done by the introduction of suitable implements and machinery, but in most tropical plantation crops there is a limit to the use of implements and a certain amount of tillage will probably have to continue to be undertaken by hand labour for a good many years to come.

A hopeful line for producing bigger acre yields and for obtaining a higher quality product lies in the direction of improving the variety cultivated by the application of scientific methods of plant selection. This system has been applied with great effect for years past to crops of the temperate zone, but has only of recent years been applied to the Tropics. This is particularly the case with the orchard or plantation crops of the Tropics since they are mostly perennial and therefore entail prolonged periods of careful observation before the actual results can be visualized. Nevertheless sufficient has already been done to prove that in this direction a vast field for effecting improvement awaits the investigator. One has only to go into an ordinary

MALARIA IN BARBADOS.

Report and comments by Dr. Seagar, Professor of Sanitation and Hygiene.

[*Dr. Seagar visited Barbados in November last to investigate an outbreak of fever. Extracts from his report, together with some subsequent comments are published below. Illustrations will be found on page ix.*—ED.]

THERE appeared to be many differences of opinion, and much uncertainty prevailing regarding the condition. I was shown many clinical charts, which demonstrated marked differences. Most of the cases showed a fever running from seven to ten days many of which apparently cleared up without Quinine being given and recurrence appeared absent. Whilst a few seemed uninfluenced by Quinine, others showed marked improvement after Quinine, but some had been ill at home for a week before they were treated in Hospital. They were not having chills, but there was a good deal of vomiting, and some cases had shewn early jaundice. The deaths were mostly in elderly and debilitated people. Splenic enlargement was absent, and the disease appeared to be milder in children than in adults.

Taking these appearances into consideration with the epidemiological facts that the supposed first cases had only been noted on the 8th October when seven of them had been notified as Typhoid Fever, and that the spread had been fulminant (over 300 cases in five weeks) in a country where the Anopheline Mosquito had never been found, even after prolonged and conscientious search, but where Culex and Stegomyia abounded, there was room for speculation.

Dr. Lionel Hutson took me out through the districts of St. James' and St. Peter, and I examined many cases, and took specimens. I examined a series of blood films and found the parasites of sub-tertian Malaria in most of them.

The next trouble was to find the Vector which could only be a species of Anopheline Mosquito.

Consequently next morning, the 17th November, I started out for the infected Parishes of St. James' and St. Peter, and while prospecting around Sandy Lane—St. James'—I saw a likely breeding place—a small grassy swamp above a pool. I tried a number of times only finding culicine larvae, but at last I discovered a single Anopheline larva (the first found in Barbados) and on continuing I found others.

I proceeded to "Six Men" and there in a grassy seepage at a place called the "Retreat," I found great quantities of Anopheline larvae.

I examined the larvae and made them out to be of the species Anopheles Albimanus Weidemann, one of the carriers of the malignant parasite, in this part of the tropical world. I have since bred them out to the adult Mosquitoes, and caught adults and they have all proved true to species.

On the 19th November I took out Sanitary Inspectors for field training in finding the infected areas, and methods of dealing with them. I found a very great many infected places, which were noted, and afterwards flagged out on survey maps. Hollows in the fields holding water, and with the grass growing up from the bottom, and entangling green algae were sites of election for heavy breeding in many cases, but even large pools, containing "millions" showed an Anopheline infection, if the edges were grass grown. I followed several of the gullies up on to the terraces, and in suitable grass grown holes containing water in the beds of the gullies, I found Anopheline larvae. I then began to recognise that Anopheline breeding was widespread on the Island, and this has been confirmed by the finding of Anopheline larvae in many places, even near Bridgetown, such as Kensington, &c.

In journeying through the other parishes on the Island, I have seen multitudes of collections of water that are suitable for the breeding of Anopheline Mosquitoes, provided there is water there for two or three weeks. The grass grown ditches holding water at the roadside I have found infected with larvae. Infected adult mosquitoes are certainly biting, and breeding in St. Michael's, St. James', St. Peter's and St. Thomas' parishes, but the breeding of non-infected Anopheline is probably more wide-spread than the actual area infected with Malaria.

The Anopheline Mosquitoes will spread over the Island in advance of the actual cases of Malaria, because a female Anopheline having had a meal of human or animal blood will look for water to lay eggs, and that brood when hatched will push on for other water to breed, but it is only when there is a reservoir of infection in the shape of a human being with the malignant crescents circulating in their blood for them to bite, that they will become infective.

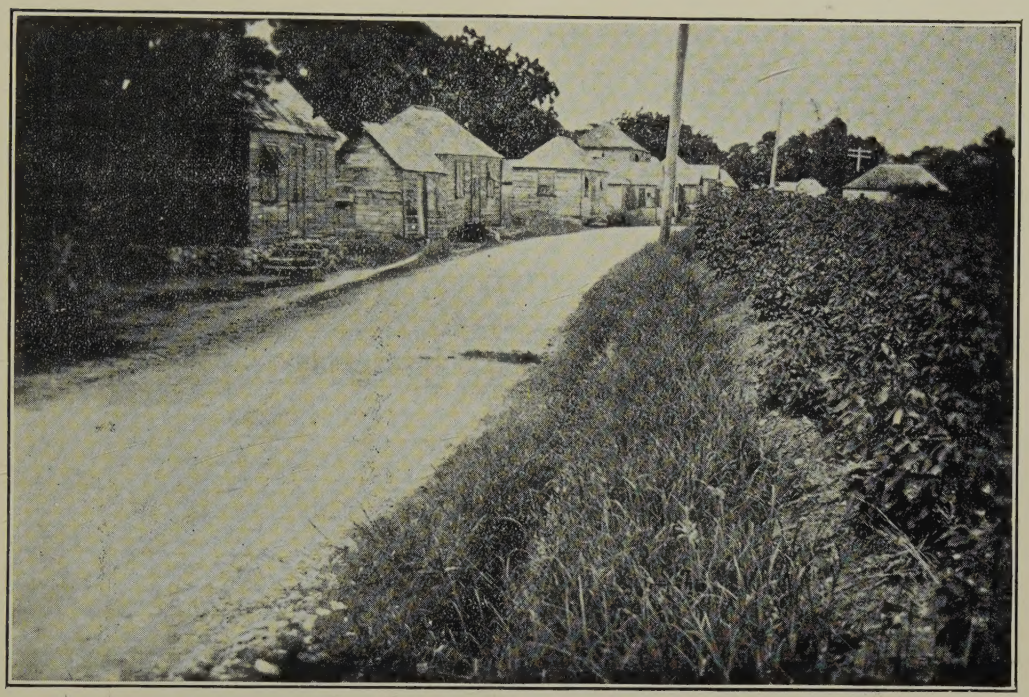
It is difficult to surmise how long Anopheline Mosquitoes have been in Barbados, but it must at least been many months, and temperature, humidity, winds and rains have apparently been favourable. The reservoir of infected blood has come probably from Cuba in labourers returning, but the conjecture as to the Anopheles landing on the leeward coast is more difficult. Probably Albimanus came in the holds of small Schooners carrying fruit from the neighbouring Antilles, or timber from Demerara.

The ordinary flying range of an Anopheline like Albimanus is about half a mile, but they can fly five or six miles with the wind, under special circumstances. The breeding time from the egg to larva to pupa to complete imago or insect, varies with the temperature and humidity of the atmosphere, but is usually 10-14 days. Then if they suck infected blood with the crescents in it, it undergoes a cycle, which takes about 10 days before the Mosquito can be infective. Then—if it bites anyone it takes 7-14 days before they show the symptoms of fever. An infected Mosquito may remain alive and spread the disease up to about 50 days.

The subtertian or malignant type of Malaria is the most dangerous, because the parasites sporulate in the internal organs, and not in th

MALARIA IN BARBADOS.

BREEDING PLACES.



The intensive Anopheline Mosquito breeding in the grass grown roadside ditches is a feature of the Barbados outbreak. The infected natives lying in the adjacent huts unprotected by netting rendered the spread very rapid.

DIPPING FOR ANOPHELINE LARVA.

This illustrates a typical grassy pool in the fields containing the slightly alkaline water favoured by Anopheles Albimanus, and most effectively treated with Paris Green.

Sir James Currie, K.B.E., C.M.G.

blood stream of the body—giving rise to serious symptoms if not treated, but the parasite is more amenable to treatment with Quinine than the other two forms, and does not tend to relapse so badly.

Failing the screening of infected individuals the houses should be fumigated with Flit or Sulphur dioxide to kill infected Mosquitoes before they go to other houses. They hide in dark corners or under the houses usually, and bite at night.

Prophylactic Quinine should be available, and adults in infected areas should take 5 Grains daily and 10 Grains once or twice a week of a soluble salt of Quinine.

Leaflets and lectures with Lantern Slides will help to educate the people to help themselves.

The collections of water that are infected or that become infected will have to be dealt with on engineering principles. Small hollows can be filled up, small pools drained into large ones that can be stocked with fish and the edges trimmed clear of grass. Grass should be cut around houses, and in and around pools. Ditches, and open tile pipe drains can be used for swampy country. Sluices or tidal flaps may have to be arranged in a few places by the sea. Oil drips can be arranged in gullies under suitable conditions.

Oil for pools should consist of Kerosene or Diesel oil mixed with Crude Oil. Castor Oil 1 per cent. helps the spreading power. It should be sprayed on the grass edges, and not the middle. The best larvacide for grassy and swampy places is Paris Green, which must contain 50 per cent. of Arsenious Oxide. It should be mixed 1 in 100 with road dust, or sawdust, and scattered on down wind. It is safe with proper precautions, and will not kill fish.

Leaving out of the picture the question of breeding places of Culex and Stegomyia such as water butts, wells, cisterns, tins, open pools round houses, brackish pools, and crab holes, &c. I have found that the breeding places of the Malarial Anopheline are widespread, and that potentially there is suitable material for a much wider and more serious spread, unless energetic and effective measures are taken to control it. It is going to be a lengthy matter, and although the coming of the dry season will help, aestivation of the Mosquito must be looked for so that to prevent severe recrudescence next wet season, men and money—those two concomitants of any warfare must be forthcoming. I am helping to train a nucleus staff for an anti-malarial campaign, but they must be augmented, and landowners must help by abolishing or rendering negative that type of water that is potential for Anopheline breeding, even before it becomes infected.

Estate owners will find that the devastating and debilitating influence of Malaria if allowed, to continue unchecked, will render it impossible for them to get effective labour. The condition has a big start and while the potentiality for spread is great, and it will take much work and vigilance to stamp it out, or even keep it under control, the one thing in this Island is that the collections of water are for the most part small, and transient, and there certainly do not exist those great swamps and river ways which in other countries prove insurmountable barriers to health and freedom, owing to cost and engineering difficulties. In time it should be achieved in this case, if the executive staff, and money are forthcoming.

Note on the characteristics of the Anopheline Larvae and adult Mosquitoes found.

The Anopheline larvae I have found are usually dark green, but may vary in colour, with the intestinal contents. They show the typical Anopheline head and thorax, and lack of posterior breeding tube. There are no rosettes of palmate hairs of the thorax (which distinguishes it from argyritarsis) but, the abdomen has seven pairs of dorsal palmate tufts, the pair on the first segment being small. The hairs of the dorsal palmate tufts are slender lanceolate. The adult Mosquito is a medium sized black Anopheles, the metatarsi of the posterior legs are white with a black basal ring on the last metatarsis—wings mottled with black and yellowish scales—palpi long and dark—last segment and base of penultimate one, white.

From careful observation of the white markings on the palpi it would appear to be Albimanus Wiedemann, rather than the tarsimaculatus variety of Albimanus.

Comments.

The question as to the length of time the Anopheline Mosquito has been operative in Barbados is a very interesting point, but one on which it is difficult with present data to get beyond the province of surmise. Considering the widespread breeding and the history of seasonal outbreaks of a fever in some of the lee-coast villages there are grounds for thinking it has been smouldering there for years, and that the recent wet season, which has been abnormally protracted and hot, has fanned it into a blaze by favouring the Anopheline breeding.

Certainly Barbados has always had a plentiful supply of people infected with malaria sojourning there and the possibility of invasion by the Anopheline carrier was pointed out many years ago by Dr. Andrew Balfour, the present Director of the London School of Hygiene and Tropical Medicine, who advocated the establishment of trap pools near to the places where the schooners tie up, as set forth in his book *The War against Tropical Disease*. Certainly the Anophelines must have come in the holds of schooners carrying timber from Demerara or fruit from the other islands.

The greater part of the breeding has been going on in the grassy pools and seepages in the fields and in the grass grown roadside ditches that hold a film of water. The big pools that

are clean edged and stocked with millions are clear and the brackish swamps and crab holes also are free. It has to be remembered that Barbados is very thickly populated and that the ground is very intensively cultivated. The surface layers are furthermore, to a large extent, of a porous coral formation so that in the dry season there is very little surface water left. All these factors should help ultimately to mitigate the condition if the right line of attack is taken. Through the dry season the aestivation of the Anopheline Mosquito will have to be watched for and studied.

Recent reports from Barbados are not very reassuring. There have been well over a thousand cases and the condition is steadily spreading. In this connection it is well to examine some statements which were alleged to have been made at a meeting of the General Board of Health and reported in the *Barbados Advocate* of the 29th November, 1927.

It was stated that the extermination of the Mosquito was a method of attack advocated many years ago but never carried out in practice, that oiling water pools was a flank attack and not a direct one. Concentration was advocated on the direct methods of attack which it is reported, consisted only in treating the patients to destroy the germs and the killing of infected Mosquitoes by swatting, &c.

If this was reported correctly it will mean that certain measures such as drainage, oil, Paris green and others recently initiated to exterminate the breeding places of the Mosquitoes will be neglected. Activity will be restricted to endeavouring to kill adults by swatting during the two months that they are flying about infected. Surely it will be more impossible to stamp out the reservoir of infection than anything else. Quinine does not kill the crescents that the Mosquitoes gain their infection from, only plasmochin will do that and it is not in use there.

In the case of an epidemic of Malaria such as that in Barbados, success can only be achieved by a vigorous attack from all angles. Certainly larva control is more important than adult control. The report of the First International Congress on Malaria at Rome in October, 1925, as well as the antimalarial work of the Rockefeller Foundation, bear this out.

Colonel Gorgas in his highly successful Malaria control work at Panama, utilised all methods of attack and placed them in order of importance as follows. (1) Drainage of breeding water, (2) Oiling, (3) Larvicides, (4) Bush and grass cutting, (5) Larvivorous fishes such as millions in breeding water, (6) Screening of houses, (7) Prophylactic quinine, (8) Killing adult Mosquitoes in houses.

The statements made before the General Board of Health seem to have been based on the experimental work of Colonel S. P. James on Anopheles Maculipennis in England, but that surely can find no parallel in the conditions prevailing in Barbados, and it seems illogical, to say the least of it, to allow the Mosquitoes to breed in the fields and roadside ditches and then attempt to kill them by swatting when they are infected and lurking during the daytime in or under the native huts. As to the sterilisation of a community with quinine, that was tried out around the Pontine marshes in Italy long ago and failed miserably. For the success of the campaign and the welfare of the people of Barbados, it is to be hoped that the whole modern armament of attack will be used. Certainly under the circumstances in Barbados the proper use of Paris green or arsenate of lime on the grassy pools and the cleaning of the roadside ditches will contribute much more to suppressing the onward march of the epidemic than serving out quinine and swatting adult Mosquitoes will accomplish alone.

THE TSETSE-FLY PROBLEM.

THE solution of the tsetse-fly problem is one of supreme importance to tropical Africa, not only on account of the losses in stock due to n'gana and other trypanosome diseases, but because of sleeping sickness in man. Many schemes for the eradication of this insect have been suggested—trapping, cutting down undergrowth, and so on. A method which has been popular with many people is the suppression of the wild game hosts and the consequent starvation of the fly. The Society for the Preservation of the Fauna of the Empire is among the individuals and bodies which have protested against this policy, and has recently issued a pamphlet urging that should extermination of game be necessary, it must be discriminate; and pointing out that epizootics of rinderpest have killed out game in parts without also destroying the fly. It is suggested also that from wild game it may be possible to obtain an immune serum for use in stock. The object of the Society, however, is mainly to preserve the big game, and much capital is made of the monetary value of these animals to the African colonies. While we cannot agree that the value of game to the sportsman should have any influence of the fight against trypanosome diseases, yet we agree that it would not be advisable to exterminate game without fuller investigations, such as those Mr. Swynnerton is carrying out. Cattle definitely carry the human parasite, and in them it causes a chronic condition. The situation has not been fully explored yet; but in any event history shows that to tamper with the balance of nature it at best a hazardous task, and (as Australian rabbits and American sparrows have shown) may be followed by unexpected consequences.—(*British Medical Journal.*)

RICE IN BURMA.

Production, Trade and Improvement.

(Concluded.)

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III. Improvement.

The rice trade dealt with in the last chapter was built up on the indigenous rices already present in the country. No sustained effort at improving the crop was attempted before, with the creation of an Agricultural Department in 1907, an experimental farm was opened in Mandalay. This was designed to deal with the Upper Burma crop, and it has now in fact produced and distributed improved varieties which are widely grown over that area. There is little or no connection between the Upper Burma varieties and those of Lower Burma where the vast bulk of the crop is produced ; but it was not until 1914 when staff and funds became available that an experimental station was opened at Hmawbi in Lower Burma to deal with the crop there. This station has produced some highly appreciated improved varieties which are now being distributed on a fairly extensive scale, and of which details will be given later. Three more stations have been opened more recently by the Agricultural Department to deal almost exclusively with the paddy crop, but two of these having been opened only so recently as last year, and the third only three years ago, sufficient time for the production of new varieties has not yet elapsed. Nevertheless the establishment of five agricultural stations equipped for experiment and plant breeding work, and dealing mainly with rice, is evidence that the importance of the crop and its improvement is receiving the consideration it demands.

At the two older stations, Mandalay and Hmawbi, the soil conditions and manurial requirements of rice have been studied and the investigation of cultivation problems undertaken. While much useful information on these subjects has been collected the only line of improvement which has yielded immediate practicable results under existing conditions has been the selection of improved varieties of grain and the distribution of seed. As already indicated the high cost of manures and the low value of paddy have rendered any advance in manuring practice difficult, although there is some prospect of this aspect undergoing a change. The chief requirements of these paddy soils are ammoniacal nitrogen and phosphoric acid, and cheaper supplies of these are now becoming available. It has not been possible to introduce any real and workable improvement in the actual method of growing the crop which could be undertaken by the class of cultivators engaged : but demonstration of the advantages of a more economical seed rate and the design of a cheap and more efficient plough by the Agricultural Department, tend towards cheapening production. In the provision of seed, however, a definite improvement has been effected and both quality and yield are benefiting thereby.

There is a large number of different named varieties of paddy in Burma, and although a complete inventory has not yet been completed it appears that there are at least a thousand varieties grown in different parts of the country. Many of the names are undoubtedly synonymous and have a local significance only. There are five distinct groups, however, into which varieties grown can be divided according to type of grain, and for improvement work a scale has been adopted which can be applied to all local varieties. In the list of hulling grades already given, three main varietal types are mentioned. Two other distinct types have been added to include varieties grown in other parts of the province, and the scale of dimensional limits adopted is as follows :—

Group Index.	Group Name.	Dimension of Grain.			
		With husk.		Husked.	
		Length mm.	Length / Breadth	Length mm.	Length / Breadth
		Over.	Over.	Over.	Over.
A.	Emata ..	9.40	3.30	7.00	3.00
B.	Letywezin	8.40 to 9.80	2.80 to 3.30	6.00 to 7.00	2.40 to 3.00
C.	Ngasein	7.75 to 9.00	2.40 to 2.80	5.60 to 6.40	2.00 to 2.40
D.	Midon	7.35 to 8.60	2.00 to 2.40	5.00 to 6.00	1.60 to 2.00
E.	Byat	9.00 to —	2.25 to 3.00	6.40 to 7.35	2.10 Awnless 2.50
		— to 11.25	2.80 to 3.40	7.30 to 8.15	2.60 Awnless 3.00

A grain broad in proportion to its length is described by millers as a "bold" grain which suffers less breakage in milling indicated by the Length/Breadth factor. A. and B. are thin grain and the other three are "bold."

A., B. and C. groups are translucent or vitreous while D. and E. are soft and opaque. Emata is a long slender shaped high grade type of rice ; Ngasein is the medium fairly short grain which is known everywhere as Burma rice ; and Midon is the round opaque type which is greatly preferred for local consumption, and finds a ready market in all eastern countries. Each of these groups is divided into early, medium, and late maturing classes, but there is, generally speaking,

an increase in life period from A. to E. Glutinous rices are not included in the present account since they are relatively unimportant and are used mostly for sweetmeats and food on special occasions.

Before undertaking the improvement of Burma rice it was first clearly ascertained that no radical change in the main type of rice produced in the country was wanted by the rice trade, but that the removal of the faults inherent in indigenous varieties was greatly desired.

These faults are chiefly (1) the presence of red grain among the white, (2) lack of uniformity in size and shape of grains of the same variety, (3) softness and excessive breakage in milling, and (4) the presence of awns. The first two faults are due to the fact that so-called varieties are in reality mixtures of varieties, and in milling on a large scale this evil is accentuated by bulking together the many different sorts of more or less one type as they reach the mill. Breakage is due to several causes but the shape of the grain is an important factor, the long thin grains breaking much more readily than the shorter and plumper grains. In the Ngasein sorts the degree of abdominal white present is also important, but breakage varies a good deal even in varieties of apparently similar characteristics. Awns of appreciable length are generally disliked and varieties with long awns are now not readily met with.

The population rices of the country provided a rich supply of material for selection purposes and at Mandalay and Hmawbi pure lines were isolated and tested from varieties collected throughout the districts. At Hmawbi 1,043 pure lines have been examined and tested, and from these, seven pure varieties of special merit have been multiplied up to a field scale and seed distribution to cultivators organised. In Mandalay a more limited range of varieties suffices and five pure varieties have been found sufficient. The main details of these improved paddies are given in tabular form below :—

VARIETY.	Life in days.	DIMENSIONS.						(8 gall.) Bushel Weight of paddy lb.	Weight of 100 grains.	
		Paddy.			Rice.					
		Lth. mm.	Bth. mm.	Thk. mm.	Lth. mm.	Bth. mm.	Thk. mm.		Paddy gms.	Rice. gms.
HMAWBI :										
A. 16-34	150	9.78	2.74	2.40	7.09	2.25	1.79	43	2.88	2.21
B. 15-1	160	8.90	3.05	2.19	6.48	2.63	1.95	47	2.68	2.15
C. 14-31	150	8.56	3.27	2.32	5.95	2.77	2.05	46	3.09	2.45
C. 19-26	170	8.98	3.32	2.20	6.33	2.83	2.04	48	3.00	2.38
C. 14-8	180	8.38	3.30	2.30	6.07	2.78	1.91	48	2.93	2.33
C. 15-10	190	8.85	3.37	2.39	6.36	2.91	2.09	48	3.16	2.50
D. 17-88	175	8.40	3.77	2.47	6.27	3.32	2.13	49	3.61	2.87
MANDALAY :										
Ngasein (2104)	194-200	8.66	3.48	2.29	6.10	2.77	2.03	47	2.90	2.33
Taungdekpan	190-200	8.81	2.64	1.93	6.14	2.21	1.73	45	1.95	1.55
Bommadewa	165-170	8.58	3.22	2.11	6.26	2.56	1.85	44½	2.44	1.96
Ngayunwa	187-200	8.53	2.49	1.88	5.96	2.18	1.77	45	1.94	1.54
Shweart	190-195	8.58	2.88	2.08	5.87	2.44	1.88	45	2.15	1.70

Life period is a very important consideration in determining the suitability or otherwise of a variety of paddy for any particular land. Where the crop is almost entirely rain fed a difference of a few inches in level between fields necessitates different varieties being sown, and life period is usually the chief consideration taken into account. The above range of varieties meets most conditions under which the main crop is grown however, while the special varieties cultivated for local consumption have been left pretty well alone.

These new varieties are a marked improvement on the old mixed sorts. The system of selection provides for careful yield tests of new strains over a period of three years in triplicated plots of $\frac{1}{80}$th of an acre each. They are tested against each other and against the original variety, and only the best yielding strains have been allowed to reach the stage of field production. As a result, the improved varieties are all good yielders, and in the hands of the cultivators yield 200 to 300 lb. per acre more than the old mixed varieties. High yield, however, is not the only consideration, and strains which show an inferior grain are discarded at a fairly early stage. The effect of selection for grain of good milling qualities has been recognised by the payment of premiums by millers for the new sorts ; and although at first, premiums were difficult to obtain, they are now paid almost without exception for paddy grown from improved seed. The premiums vary according to the degree of admixture with common paddies, for although the maintenance of purity appears easy enough, the cultivator, in more ways than one, is not well equipped for the production of a uniform high grade product. Mixing of

varieties on the threshing floor, in the brokers' hands, and even growing in the fields from ground-keepers, is far too common, and lowers the grade of the rice considerably. Even with a certain amount of dilution with other sorts the premiums paid for the new varieties vary from Rs. 5/- to Rs. 20/- per 100 baskets, and although premiums as high as Rs. 30/- have been recorded, round about Rs. 10/- is a fair average figure. That an improved strain of uniform grain, free from red contamination, is worth these premiums is borne out by the statement of one of the largest millers in Rangoon that in milling, he obtained 4·4 baskets of white rice above the average from one fairly large lot of improved paddy, with a corresponding decrease in the amount of brokens. Enquiries from small country mills in localities where improved seed has been distributed, also indicate that the milling outturns have increased and that the rice is better.

The demand for improved seed has always been greater than the supply and although the supply has been increased from year to year it has never been able to meet full requirements. The amount sent out from Hmawbi alone has grown steadily from 2,406 baskets in 1921 to 8,350 baskets in 1926. The total quantity of improved paddy seed issued by the Agricultural Department in 1926 amounted to 1,800 tons or sufficient for 80,640 acres. There is a complete absence in Burma of seed merchants in the western sense of the term and the whole of this distribution work has had to be undertaken by the Agricultural Department. The method followed has been to supply seed from the Central Experimental Farms to seed farms, either Government or private, in each district, to multiply for local distribution. In each district there is one or sometimes two agricultural assistants who organise and carry out this work. To increase the supply of seed a number of new seed farms are being opened in all districts from which pure seed certified by an officer of the Agricultural Department will be distributed. Some of these are already in operation, and when in the course of the following year the remainder are opened, will number in all 92 farms comprising 4,835 acres of good paddy land. The land is either grazing ground land which has been handed over to the Agricultural Department, or, in important centres where no such land was available, land bought for the purpose. It is difficult to set down an exact figure for the total acreage under the improved strains of paddy, for there is a certain amount of interchange of seed among cultivators themselves but a quarter of a million acres may be taken as a fairly conservative estimate. With the opening of new seed farms the rate of increase should be accelerated and it should be only a matter of time till the main bulk of the crop is raised to a definitely better standard.

The possibility of improving Burma rice by means other than that of single plant selection has never been lost sight of, and varieties from other rice-growing countries have been introduced from time to time and grown at the two main experimental stations. A fairly comprehensive collection of the best varieties from all important rice-growing countries has now been made, but apart from a short lived Japanese variety, none of these has shown much promise under local conditions. A certain number of crosses for particular characters have been made but the resultant material has not yet reached a stage where its value can be properly assessed. The most interesting crosses have been between pure strains of Burma varieties themselves, and a cross between C14-8 and C15-10 now in the F3 generation is likely to be particularly useful. C15-10 has a very superior quality of grain but its life period is so great that its scope is restricted. C14-8 suits a very wide range of conditions but its grain is smaller and not quite so good as C15-10 : neither is it so robust as C15-10 and in years of severe insect attack it is not so resistant. Some very promising plants have been obtained but several years must elapse before final results are assured. Other crosses with exotic varieties are also in hand but as already stated no final results are yet available.

The demand among cultivators for shorter and shorter lived varieties of paddy is very marked. In years when the late rains fail the shorter lived paddies certainly succeed best but there is no doubt that the demand for early maturity can be carried to excess. The great popularity of C19-26 which is the most recently introduced variety is due to its ripening ten to twelve days in advance of the ordinary Ngasein crop, and combining this early maturity with a very high yield and a robust constitution. The quality of the grain, however, is not so high as C15-10, but crosses have been made to see what can be done to improve on this.

For flooded areas where paddy can only be grown very late in the season after the floods have subsided, there is a real need for a good short lived paddy between 90 and 120 days, but although many have been tried, a really satisfactory strain has not yet been found. For deep water areas again, where a paddy which will stand five or six feet of water is required, several strains of better class white paddy have been isolated to replace the red and inferior varieties now grown under such conditions. Although the number of new strains being handled every year shows a tendency to increase rather than diminish, but with a fairly good range of improved varieties already in production, new selections find it difficult to establish a place in the sun. There is still room for considerable improvement in even the best improved varieties ; but the steps have necessarily become smaller although there is no reason to think that they have altogether ceased.

The following appointments have been made by the Secretary of State for the Colonies during the month ended 31st December, 1927.

Mr. A. E. S. McIntosh, B.Sc., Assistant Geneticist, Barbados.

Mr. K. E. Toms (Horticulturist, Zanzibar) Assistant Superintendent of Plantations Amani Institute, Tanganyika Territory.

BANANAS AND CITRUS.

Report by Dr. Harland on his tour for the purpose of studying Bananas and Citrus.

(*Continued*).

SECTION III.

HAWAII.

I arrived in Honolulu on the 22nd August. On my arrival there I heard that Mr. Otto Reinking, who had been commissioned by the United Fruit Company to collect bananas in the East, had spent several weeks on the Hawaiian Islands and had apparently covered the ground very thoroughly. I therefore determined to spend as short a time as possible in Honolulu, and thus stayed only a week, leaving on the S.S. *President Pierce* for Yokohama on 28th August.

Banana Varieties in Hawaii.—Mr. W. T. Pope, of the Agricultural Experiment Station, has made a study for several years of banana varieties in Hawaii. From the excellent photographs in his possession and from personal observation in the fruit markets I formed the opinion that there were no indigenous varieties of outstanding merit worth importing into the West Indies. Gros Michel variety is already present in the Island of Oahu, and goes under the name of Bluefields, having been imported from the Bluefields district of Nicaragua some years ago. Other varieties grown are Maiamaolo, Brazilian and Red Spanish. The only important disease appears to be the freckle disease, which is, however, not very troublesome. At the Experiment Station about twenty-five varieties were being grown, but were not in a good condition for study. Mr. Pope is preparing a bulletin on the bananas of Hawaii, copies of which he has promised to send when available.

Banana Trade with the United States.—In recent years a considerable export trade in bananas has sprung up with California. There is said to be a growing demand for Hawaiian varieties in mainland markets, and there is a reasonably good freight service to San Francisco by the Matson Line. I was introduced to Mr. A. J. Campbell, the President of the Banana Growers' Association, and he was kind enough to supply me with valuable information, a resumé of which follows at this point.

At present about 250,000 bunches per annum are exported to the mainland. The all-in cost per bunch f.o.b. is 24 cents per lb. Only the Canary or Chinese variety is grown. The Gros Michel is not regarded as suitable, as it suffers from uneven ripening, and the fruits have a soft skin and readily break away from the bunch. The description of the behaviour of the Bluefields variety, which, as has previously been said, is really Gros Michel, reminded me of the behaviour of Giant Fig in Trinidad. It is clear that shipping qualities may be greatly influenced by environmental conditions.

The largest single acreage is 150 acres, but my informant was not able to tell me the total acreage. The cost of shipping to California is at present 40 cents per bunch. The bunches are not crated, but are wrapped up in dry banana leaves. The cost of packing is 10 cents per bunch, and the bunches are carried as deck cargo in tiers of three, The lower tier is upright and the upper two are laid flat on the top of this.

It is the custom to give high cultivation to the banana groves, and up to two tons per acre of mixed fertilisers are used. The plants are set at the distance 7 feet by 8 feet.

No seeds have been noted in either Gros Michel or Chinese.

Varieties of Lime in Hawaii.—Through the kindness of Mr. Westgate, I inspected the citrus collection at the Experiment Station. The only varieties of lime there were the Tahiti and Kusai types, both of which we have already in the West Indies.

SECTION IV.

JAPAN.

I was strongly urged by Dean Merrill, of the University of California, to spend a few days in Japan. He has spent several years in the Orient and has an intimate knowledge of botanical problems. He was of opinion that the citrus industry of Japan would repay study, and provided me with a letter of introduction to Dr. Joji Sakurai, Director of the National Research Council of Japan. I arrived in Yokohama on the 7th September and proceeded to Tokio, where I immediately got in touch with Dr. Sakurai. I interviewed Mr. Hayata, the Director of the Tokio Botanical Gardens, a well-known taxonomist, who has worked extensively on the botany of Formosa, and Mr. Ando, Director of the Imperial Agricultural Experiment Station near Tokio. The time of my visit was, however, unfortunately chosen. Most of the men who could have given me exact information were away on holiday, and funds did not permit of extensive travelling in Japan. I was able, however, to get some information on the banana industry of Formosa.

The Banana Industry of Formosa.—A big banana industry exists in Formosa, supplying the whole of the Japanese market and also the market Shanghai and Korea. The variety grown is the Hokuchu, which I did not recognise as having seen before. It does not stand shipping without being crated, and thus comes into the same class as the Chinese banana. Information on the industry is written entirely in Japanese, and I thought it advisable to endeavour to secure all the publications on the subject. I went to the British Embassy in Tokio, and they promised to do their best to get a collection of literature together, using official channels. I was advised by Dr. Sakurai to adopt this method. I saw some of these publications at the Imperial Agricultural Station and they appeared to be extensive. It might be worth while having translations made,

Citrus in Japan.—There is considerable trade in Mandarin oranges between Japan and Western Canada, but at the time of my visit there were no ripe fruits in the shops, and the only citrus fruits I saw were imported from California. I did not see or hear of any varieties suitable for cross breeding with limes. The Kusai lime, which is known to be immune to wither-tip, probably comes from the island of that name in the Japanese Caroline Islands, but was probably taken there from some other part of the Orient.

SECTION V.

THE PHILIPPINES.

I left Japan on 19th September for the Philippines and Malaya, and arrived in Manila on 1st October. I had a letter of introduction to the Governor of the Philippines, Major-General Wood, and he put me in touch with the Bureau of Science. Dr. Brown, of the Bureau of Science, informed me that Dr. Reinking, whom I have mentioned before as travelling for the United Fruit Company on practically the same mission as myself, had just completed a stay of several months in the Philippines and had got records of more than 350 different varieties of banana. He had apparently thoroughly combed the Archipelago, and it did not seem much use my staying to cover the same ground. The Gros Michel variety does not exist in the Philippines, and most of the best varieties, such as Lacatan, are known in the West Indies. I therefore determined to push on to Malaya as quickly as possible, and thus remained in Manila only for the three days the steamer was in port. I visited the College of Agriculture at Los Banos, thirty miles from Manila, and had an interesting day inspecting the work there. Unfortunately I missed Dean Baker, who had gone to Manila the same day I went to Los Banos.

SECTION VI.

MALAYA.

I arrived in Singapore on the 6th October, and called the same evening on Mr. Holttum, who is in charge of the Botanical Gardens. He had no information about bananas and advised me to go to Kuala Lumpur, the headquarters of the Department of Agriculture. Accordingly I left Singapore on the 7th and arrived in Kuala Lumpur the same evening. On the morning of the 8th I called on Mr. Shaw, the Secretary for Agriculture, and also wrote to the Chief Secretary, asking for an interview. Mr. Shaw took me to the headquarters of the Department, and introduced me to Messrs. Sharples and Belgrave, the Mycologist and Plant Physiologist, respectively. The Department had very little detailed information about bananas, as its activities have mostly been confined to crops of commercial importance. Nothing is known of the Panama disease in Malaya. The person most likely to possess information on bananas, Mr. W. N. Sands, the Assistant Economic Botanist, was unfortunately away in the north working on rice, and I did not see him until the 14th, and then only for a short time.

On the 9th, Mr. Bunting, Senior Agriculturist, took me to the Serdang Experiment Station to see the collection of bananas there. The collection was composed of about twenty or thirty varieties, and among them was the variety Pisang Embon, which Mr. Sands, having spent many years in St. Vincent, had previously informed us, was similar to, or identical with Gros Michel. The plants were not in a good condition for study; the land was poor, and there was a fair amount of disease. I noticed three diseases new to me: (*a*) a rot of the pseudo-stems beginning with the shoot and working downwards, (*b*) a leaf disease causing a progressive die-back from the margins inwards, and (*c*) a very dangerous disease—a mildew and rot affecting the fruits when about an inch long, and causing the destruction of the entire bunch.

On the 10th, I talked over the matter of banana disease with Mr. Sharples, and he promised to look into the matter. The Department were not in possession of any information as to their distribution or destructiveness.

On the 12th, Mr. Shaw took me to Hot Springs, fifteen miles from Kuala Lumpur, to see Pisang Embon in Malay compounds. I saw some good specimens and was able to confirm Mr. Sand's view that Pisang Embon is probably Gros Michel. A Malay cultivator stated that this variety was attacked by a disease which occasionally spread through a compound and killed all the plants. The symptoms of the disease appeared roughly to correspond with those of Panama disease, though as no specimens were available for examination nothing further can be said.

On the 13th, I visited the fruit market in order to see Pisang Embon in quantity. There were two other varieties which were similar in character to Gros Michel. The Pisang Hijau apparently differs only in being green when ripe, while the Pisang Bunga may be the same as Gros Michel.

I went out to the Serdang Experiment Station with Mr. Sharples on the 14th to make a further examination of the banana collection from the disease point of view. He was of opinion, that there was no case resembling the Panama disease, but stated that he would go into the three diseases previously mentioned.

I left Kuala Lumpur for Penang by the night train on the 14th and arrived in Penang on the morning of the 15th. I called on the curator of the Botanic Gardens, Mr. Flippance, and was fortunate enough to meet one of the clerks in his office who was a native of Goa, in India, and who knew something of bananas. It appeared that Pisang Bunga was a synonym of Pisang Embon. On being asked whether he knew anything of the distribution of Pisang Bunga, he said that he thought it was present in Burma. This decided me to make a change in my itinerary. My original intention was to have proceeded next to Sumatra and Java, but from what my informant said Pisang Bunga was clearly a mainland variety and not an island one, and I have the further information from one or two Malays that Pisang

Bunga had been taken over to Sumatra from Malaya and was not common there. I therefore formed the impression that Pisang Bunga probably extended from Malaya up into south-eastern Asia, and that either Burma or Siam should be explored. Investigations in Siam would probably be more difficult to carry out than in Burma, and this induced me to concentrate on the latter country.

Mr. Mason, the District Agricultural Officer, came to see me on the morning of the 16th, and we visited some Malay compounds to see Pisang Hijau. On the evening of the 16th I left for Rangoon by the s.s. *Elephanta*.

(*To be continued.*)

LIMES IN DOMINICA.

At a meeting of the Dominica Agricultural and Commercial Society, held last year, Mr. F. G. Harcourt, Agricultural Superintendent, delivered an address on "Lime Varieties in Dominica" giving an account of the results so far obtained in the attempt to find or produce a lime resistant to the Withertip disease, and at the same time sufficiently like the West Indian Lime so that its fruit and other products can be utilized in conjunction with the present lime trade, and of such characters that it may be profitably grown.

There are certain of the coastal areas in the island where the Withertip is not virulent enough to prevent the present lime from being cultivated, but in some of the wetter districts it is necessary, if limes are to be grown at all, that an immune variety should be found for these districts. Withertip made its appearance in Dominica in May, 1922, and since that time efforts have been made to find an immune lime, whose yield of juice, acidity, flavour and quality of oil approximates the West Indian Lime. Other essential, or desirable points are prolificness in bearing, quickness and habit of growth, size and shape of fruit, shedding of fruit and method of propagation.

At that time (1922) in addition to the ordinary lime there were in Dominica under the observation of the Agricultural Department two varieties, the Rangpur Lime and Citrus Hystrix.

In June, 1923, the first budwood and plants of other varieties were received from the United States Department of Agriculture and since that time there have been 20 importations from the United States Department of Agriculture, the Agricultural Department, Hawaii, the Agricultural Department, Trinidad, and the Commissioner of Agriculture for the West Indies.

During the course of the work 1,700 plants of new varieties have been distributed to 19 estates and an experiment plot similar to the Department plot on Morne Bruce has been established on Melville Hall Estate on the Windward side of the Island. The main objects of this distribution have been to enable planters, who rarely have the opportunity of visiting the Department, to have the varieties constantly under observation, to provide a thorough test of the varieties as to immunity from Withertip disease and to provide propagating material on the spot, if it should be desired to try any of those varieties in extended cultivation.

Mr. Harcourt in discussing the varieties of acid fruits, which have made sufficient progress in the trials to give any results on which to base an opinion as to their merits, cautioned his hearers that the report was only in the nature of a progress report and that it was not to be considered that any final conclusions had been arrived at.

The Kusai Lime.—This variety did not do well on sour orange stock; rough lemon was found to be more satisfactory as a stock. Mr. Harcourt records his disappointment with this variety. It was at first hoped that it would prove valuable for replacing the West Indian Lime, but its green fruits are useless for the green lime trade, the juice is unsuitable for raw juice and the oil has an aroma decidedly different from that of the West Indian Lime. It appears, however, to be immune to Withertip.

The Rangpur Lime.—This variety like the former is disappointing for though it is immune to Withertip its juice and its oil are not suitable for the Dominica trade.

The Eustis Limequat.—The previously mentioned varieties do not shed their mature fruits; this one, however, drops its fruits on ripening, but while it has grown well in some places, in others it is not hardy and the trees appear to be slowly dying. The skin is smooth and very thin, breaking in the ecuelling pan and the flavour of the juice is different from that of the West Indian Lime. The acid content of the juice (12 ozs. per gal.) is higher than in the case of the Kusai and the Rangpur.

The Woglum Lemon.—The tree has the habit of the lemon, it is spineless, a heavy bearer and apparently immune to Withertip. The fruit is large, more like a lime than a lemon in outward appearance, with plenty of juice with rather low (10·4 ozs. per gal.) acid content. The juice and the oil are unlike the lime.

Citrus Hystrix.—This tree bears a large fruit, almost twice the size of the ordinary lemon. Its juice has a high acid content (13·66 ozs. per gal.), but in flavour, colour and aroma is different from the lime. It is not considered likely to prove of much use in Dominica, except possibly as a stock for other varieties.

Citrus aurantifolia is considered as possibly being suitable for the green lime trade and for the production of concentrated. It has the reputation in Trinidad of being a heavy bearer and it comes into early bearing—in the second or third year. This is considered to be a variety of promise well worth watching, but so far it has not produced enough fruit in Dominica for satisfactory tests to be made.

Bear's Seedless is said to be an improved type of the Tahiti with a reputation for heavy bearing in Hawaii. The fruit are likely to be suitable for

the green lime trade and the juice is similar to that of the lime in appearance, flavour and smell, and the acid content is fair. The essential oil is also similar to that of the West Indian Lime in aroma. This is considered to be a promising variety.

The Tahiti Lime is also considered a very promising variety for cultivation in Dominica. The juice is similar to that of the ordinary lime and the fruits would probably be suitable for the green lime trade. It is said to grow a round-topped tree twelve to fifteen feet high and to be of a healthy and vigorous growth, but the shoots are brittle and easily damaged by wind. The fruits, however, do not drop readily from the trees on ripening. In addition to being immune to Withertip it is said also to be immune to citrus canker to which disease the West Indian Lime is highly susceptible.

The Woglum Lime.—The points in favour of this variety are said to be—It is spineless, bears well, is immune to Withertip and is the only variety under trial that drops its fruit with a degree of readiness approaching the West Indian Lime. The juice and the oil are similar to those of the West Indian Lime.

The varieties so far mentioned are all immune to Withertip so far as observed up to the present time. Of these the Woglum Lime, the Tahiti and Bear's Seedless approximate the West Indian Lime in essential points:—Tahiti and Bear's Seedless in flavour of juice, acidity and aroma of expressed oil, and Woglum's Lime in acidity and aroma of oil. The Everglade Lime which is said not to be immune to Withertip has the reputation of fruiting heavily under conditions which are destructive to the ordinary lime.

Other interesting varieties are under trial and observation. They include a cross between the lime and the lemon presented by the United States Department of Agriculture and a variety obtained from Burma by the Imperial College of Tropical Agriculture.

Eighty-four crosses were made between the West Indian Lime and the new varieties, but the high winds of the storm of July, 1926, stripped the fruits from the trees and only one plant has been obtained from these crosses. The work of crossing will be continued in the hope of obtaining a hybrid immune to Withertip and possessing the desirable qualities of the West Indian Lime.

The Agricultural Department in Dominica has issued a New Year's message to the agricultural community, in which Mr. Harcourt's lecture is reviewed and the present situation and prospects outlined.

It is stated that Mr. Harcourt reported favourably on three varieties. Bear's seedless, Tahiti, and Woglum's Lime, while two other promising varieties mentioned were Citrus Everglade, and Citrus aurantifolia, but that no definite recommendations for the future were made.

Observations have proved that even in sheltered situations the brittle young shoots of Bear's seedless and Tahiti are broken by the winds to such an extent as to render them unsuitable for Dominica conditions. Both Woglum's Limes and Citrus Everglade suffer from Withertip.

It is felt that observations to date compel the Department to abandon hope that any of the above varieties should seriously be considered as (1) economic propositions, (2) to replace the West Indian Lime, and (3) to supplement the lime juice trade by planting in Withertip areas.

The recommendations now made are that the West Indian Lime should continue to be planted in localities known to be suitable, and that other crops should be cultivated in Withertip areas. The Department proposes to carry on the search for a suitable immune variety. Work in hybridisation has been carried on during the past year. Eighty crosses have been made, and 1,050 seedlings raised.

There has been during the past 18 months a great increase in the demand for budded citrus plants, particularly, of West Indian Lime budded in sour ornage stock. The sour orange material for the budding has been exhausted, and new supplies are being raised, and it is suggested that all available sour orange stocks should be used for budding the West Indian Lime for the present.

LIMES IN TRINIDAD.

THE following note taken form *The Agricultural Notes*, recently issued by the Trinidad Department of Agriculture, should be of interest in connection with the preceding article, recording as it does the same lines of work being carried on in another locality, and in a spirit of co-operation.

As is probably well known the Department of Agriculture has for some years past been collecting various kinds of limes in the hope of obtaining a marketable lime immune to Withertip disease.

After these introduced plants had been established and come to maturity plant breeding work has been undertaken on a small scale between some of them and the West Indian Lime. The most interesting result of this latter work has been obtained from a cross between *C. aurantifolia* No. 1013 used as the male parent and the common West Indian Lime as the female.

From about 20 plants raised seven have so far shown no signs of Withertip. These plants are distinct and show characters intermediate between the two parents. No opinion can of course yet be given as to their commercial importance. The remainder which are very like the West Indian Lime have suffered badly from Withertip disease.

The seven immune plants have been propagated by budding and about 50 plants of each raised for further trial in Trinidad and also distributed to the islands of Dominica and St. Lucia.

Future work will consist in breeding the progeny of this cross with the ordinary lime, the aim being to get a lime as similar as possible to the West Indian with the resistant characters to Withertip of *C. aurantifolia.*

TROPICAL WORLD NOTES.

Basutoland.

During the last year there was a decrease in both the import and export trade of Basutoland. Statistics published in the latest Colonial Report (No. 1336, H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 9*d.* net.) show that imports amounted to £665,014, as against £812,547; while exports at £696,950 were nearly £60,000 less than those of 1925. Merchandise imported last year was valued at £593,919 (£733,173), and of the exports wool, mohair, and wheat and wheatmeal were by far the most important. Wool, as usual, was the chief, and amounted to £427,047, as compared with £469,315 in 1925. Mohair was exported to the value of £121,098 (£119,285), and wheat and wheatmeal was sent out of the territory to the value of £111,694 (£105,558). In quantity total exports of wool and mohair amounted to 16,655,056 lb., of which 14,288,177 lb. were exported by general traders. Other products included in the exports last year were hides and skins, cattle, maize, Kaffir corn and beans and peas.—(*The Chamber of Commerce Journal*, Vol. LIV, p. 170.)

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Ceylon.

Prior to his departure for Malaya, Sir Hugh Clifford has succeeded in devising a method of solving the problem of rehabilitating the vast number of landless loafers, who declining to accept work on European owned plantations, either go to swell the criminal population, or die in indigence and penury. It is proposed as a commencement to allocate an area of two hundred square miles, or 128,000 acres, for division amongst 25,000 families. These holdings are either to be sold outright in the first instance, or let on easy terms of lease with the right of eventual purchase, to *bona fide* cultivators. The jungle is to be filled, the land cleared, surveyed and divided into blocks, bridges, culverts and permanent roadways to meet the requirements of the next five hundred years are to be constructed and facilities for transport and communication provided. Arrangements will be made for cash advances to be given to cultivators for the purpose of developing the land and sustaining themselves and their families in reasonable comfort until the land becomes productive.

* * *

West Africa.

Sir Alexander Ransford Slater, K.C.M.G., C.B.E., Governor and Commander-in-Chief of Sierra Leone, has been appointed Governor and Commander-in-Chief of the Gold Coast, in succession to Brigadier-General Sir Frederick Gordon Guggisberg, K.C.M.G., D.S.O., whose term of office is about to expire.

Brigadier-General Sir Joseph Aloysius Byrne, K.B.E., C.B., Governor and Commander-in-Chief of Seychelles, has been appointed Governor and Commander-in-Chief of Sierra Leone, in succession to Sir Ransford Slater.—(*African World*, Vol. XCIX, p. 65.)

West Indies.

An unofficial conference in the interests of the growing and marketing of West Indian fruits and vegetables was recently held in Barbados and the delegates proceeded to Trinidad in order to take advantage of the presence there of Mr. Percy Hurd, M.P., Secretary of the West Indian Parliamentary Committee and to consult with him on the problems confronting the West Indian growers of produce of this nature. The Conference was organised by Captain Geo. C. Cook, West Indian Superintendent of the Canadian Merchant Marine. Delegates were present in Barbados from the Leeward Islands, St. Kitts, Montserrat, Dominica and St. Lucia. The delegates came on to Trinidad in time to attend the meeting of the Trinidad Chamber of Commerce at which Mr. Hurd met the Committees from the Commercial and Agricultural bodies of Trinidad. Later in the same day, Mr. Hurd attended another meeting with these delegates. The whole subject of organisation for production and marketing was discussed and it is hoped that as a result Associations may be formed in the several islands, in co-operation, which will make possible the employment of a competent man to develop a trade, by supervising the packing, shipping and marketing of fruits and vegetables from the West Indies for the Canadian market.

The report of the West Indian Air Transport Committee, of which Air Vice-Marshal Sir W. Sefton Branker was Chairman on the opportunities for the operation of civil air transport in the neighbourhood of the West Indies states opportunities exist for the advantageous employment of aircraft on survey work and to facilitate administration. Aircraft could be used in particular in the Bahamas in connection with the administration of the lighthouse service, and it is recommended that investigation should be made in Trinidad of the possibility of employing aircraft to "dust" the sugar cane areas for the purpose of eradicating insect pests. A scheme for an Air Service covering the whole area of the West Indies is not yet considered commercially practicable.

* * *

Java.

The 1927 sugar campaign in Java has ended and the final figures of production are now known. The total outturn is 2,359,041 long tons while the production of the mills represented by the United Java Sugar Producers is 2,143,503 long tons, of which 2,098,150 tons have been sold.

Of the 1928 crop 8,700 tons of molasses sugar was sold by the middle of January at 13 florins per 100 kilos. Buyers are of opinion that there is little room for an advance in prices but plenty of opportunity for a fall. Total sales of the 1928 crop by the Syndicate now amount to 409,900 tons.

It is reported that the condition of the growing cane is un-even. In Mid-Java the rainfall during the second half of last month was much lighter than during the first half. In East Java the rains are increasing but are not general yet.—(*Facts About Sugar*, Vol. XXIII, p. 29.)

British Guiana.

Professor Dash's scheme for the re-organisation of the British Guiana Agricultural Department, is of particular interest to readers of this Journal, because he was until recently, Professor of Agriculture at the Imperial College, and because British Guiana is a close neighbour to Trinidad. There can be little doubt in the minds of anyone who reads through Mr. Dash's proposals, that the Department of Science and Agriculture, as it is called, is sadly in need of re-organisation, and the measure of this may be gauged from the changes now proposed.

The general trend of Mr. Dash's proposals is to define the scope and duties of an Agricultural Department, and show how by getting rid of what should not be included, and taking up lines of work which at present have been sadly neglected, the Department of Agriculture, the name now proposed, can become of real assistance to the Colony. The Government Analyst's Section, and the purely ornamental portion of the Botanic Gardens, are to be separated from the functions of the Department, while the Board of Agriculture becomes obsolete. With these proposals there will be little disagreement: it may be held by some that Mr. Dash is unnecessarily vigorous in calling a spade a spade, but reading between the lines, it is clear that the situation demanded plain speaking. Having thus cleared the ground, Mr. Dash puts forward quite clearly the requirements of the Department, as he sees them, and of these, the immediate foundation of a number of Agricultural Experimental Stations, seems to us the most important. These stations are each to be under the control of an Assistant Superintendent, of the Imperial College Diploma Student type, and are to serve not only for the actual practical experimental work that is fundamental to any real progress, but also as centres for the multiplication and distribution of good seed, while livestock sires of good quality will also be stationed there. The proposals for extension work are rather vague: apparently the agents are to be Agricultural Instructors, but of what stamp is not mentioned, while there are to be two Agricultural Superintendents, working as intermediaries between the stations and headquarters. It is suggested that a more efficient organisation would be the appointment of District Agricultural Officers who would be responsible each for their own circle, and who would control all the work, experimental, routine and extension in the circle, with a sufficient number of subordinates who would be interchangeable between the station and the district. In this way the whole staff would be trained both in experimental and extension work, with the double benefit that the men arranging and carrying out the experimental programme would be thoroughly in touch with the needs and difficulties of the district, while the men who carried the good news to the farmers would have had actual experience of growing crops in the locality.

The management of the present sugar station at Sophia is a purely local question; there seems little room to question the Director's view that it should be taken over by his Department. We would deprecate regarding it as a special sugar-cane station: it should be looked on as one of the Agricultural Experiment Stations of the Colony, with a special bias towards sugar-cane work—it is presumably located in a sugar-cane area—but prepared to study any other problems that are of interest to the circle of which it is the headquarters. The actual control of special breeding work would be under an Agronomist, by agreement with the District Agricultural Officer.

The special circumstances in which much of the cultivation is carried on in British Guiana have drawn very special attention to questions of drainage, and Mr. Dash stipulates for the appointment of an Agricultural Engineer to deal with the numerous problems involved.

Such in brief is the substance of Mr. Dash's proposals. He has not overlooked the need of improving the livestock of the country, nor the means of making a start with the very large question of Agricultural Education, but these call for no comment.

Mr. Dash has tackled his problem vigorously and we wish him all success. It would perhaps have been wiser to have confined himself to a statement of the general lines of policy and the reorganisation necessary to carry them through, and with these accepted, proceed to the details of appointments and buildings, which occupy a considerable portion of the paper, and which in the heat of debate may obscure the more important issues. Mr. Dash has an uphill struggle before him, and will need all his energy to win through.

R. C. W.

* * *

Palestine.

According to a report by the Director of Customs and trade at Jerusalem, the introduction into Palestine of new staples promising higher acreage results is being organized by the Department of Agriculture, selection being made of crops the production and preparation of which call for no considerable outlay on machinery, and no special expenditure except for labour. Oil seeds, such as ground-nuts, linseed, sunflower and soya beans, and fibres such as cotton, flax and hemp, which find a ready market locally in oil and textile mills, soap factories, &c., are being encouraged. The past season was not favourable from a weather point of view, but good results were obtained at forest nurseries with ground-nuts, flax, and sunflower, where a deficient rainfall was supplemented by irrigation. Banana cultivation is increasing. Subsidiary industries for the production of perfumes, medicinal barks, &c., have been established. Liquorice roots from the Jordan Valley are in good demand.—(*Journal of the Royal Society of Arts*, Vol. LXXV, p. 1079.)

COTTON PHYSIOLOGICAL PROBLEMS.*

BY T. G. MASON AND E. J. MASKELL,
Physiological Botanists, Cotton Research Station, Trinidad.

THE following is a short note indicating the work carried out by the Physiology Department at the Trinidad Research Station during the past year. Many of the problems that confront the cotton physiologist are such that to the non-technical reader it is not obvious that their ultimate bearing upon the successful growing of cotton is a very important one. Among so many, the selection of those which are both of great practical importance, and likely to yield results within a reasonably short time, is by no means easy; but, after careful consideration, it was decided that attention could most profitably be devoted to the following:

(1) The shedding of flower-buds and young bolls.
(2) Variations in form and development of the plant as a result of climatic and other causes.
(3) The condensation of sugar to form cellulose in the lint hair, thus thickening the hair into a definite fibre.

1. *Shedding.*—There is a very general impression that shedding is often responsible for a great loss of crop, and that the loss could be minimized if the causes were known. A great deal of work on shedding has already been done, but as yet only a limited amount of investigation has been carried out with a view to ascertaining what is happening inside the plant in periods preceding shedding. To make our meaning more clear, we will consider the shedding of flower buds and young bolls separately.

As regards the shedding of flower buds, cotton can, broadly speaking, be divided into two classes, the first characterized by the fact that if planted during the rains they continue to shed their flower buds until the advent of the dry season. It is still uncertain whether the change in relative length of day and night, and not the change from wet to dry conditions, may not be the causative factor. The native cottons of West Africa are generally of this type, and also the Serido cotton of Brazil and the Marie Galante cotton of the West Indies.

In the second type, to which belong American Upland and Sea Island, flowering is not normally postponed in this way, but begins at a definite period after planting, irrespective of the time of sowing; thus, in the West Indies, Sea Island cotton always flowers approximately eight weeks after planting.

The question arises as to what are the underlying causes responsible for these differences in the two types of cotton. The plant, as is well known, makes use of the energy provided by the sun's rays to manufacture sugars from the carbon dioxide in the air. This action takes place in the leaves, and the sugars are then distributed throughout the plant and provide 80 to 90 per cent. of the raw material out of which new tissues are formed. The growth of the roots, stem, and fruit depends, therefore, very largely on a continuous movement of sugar from the leaves to the other parts of the plant. It may be that in the first class of plants sugars manufactured in the leaf travel during the rainy season to regions where growth of leaves, stem, and roots is proceeding, and that the flower buds, unable to obtain the supply of sugar necessary for growth, are consequently shed. In any case it seems likely that the machinery of sugar transport is in some way involved. It is possible also that the absorption and movement of nitrogen in the plant may play an important part.

In the case of the young boll, shedding is often rampant* in periods of wet weather. Generally speaking, a sudden change in humidity leads to a wave of shedding. The amount of shedding may also vary greatly from year to year. The causes of these phenomena are quite obscure, and little progress can be made in understanding them until much more is known about the factors determining the supply of sugar and nitrogen to growing organs. Again, all types of cotton, more especially those evolved in a dry climate, tend to "run to bush" in wet weather, vegetative growth proceeding at the expense of the reproductive centres. The mechanism by which food materials are thus diverted from reproductive centres to vegetative centres is clearly part of the general problem of translocation.

2. *Variations in Form and Development.*—As an illustration of this problem, we may consider the root development of American cotton in Southern Nigeria. For more than twenty years attempts to introduce this type of cotton have proved abortive, and have at last been discontinued, work now being concentrated upon the improvement of the staple of one of the native varieties. Now there is little doubt that the failure of the American type was very largely due to the fact that its root system is poorly developed as compared with the native type, for cotton in Southern Nigeria is grown among yams, maize, &c., and has consequently to compete with other crops for soil nutrients. There is moreover, little doubt that the meagre development of the root system in American cotton is correlated with its habit of early flowering* and the way in which it produces its crop in a comparatively short period. In addition, there is some danger that if the native type at present being evolved

* It is hoped that a paper giving full details of the work undertaken and the results obtained, of which this memorandum is but a summary, may be published shortly in the *Annals of Botany*. In that case reprints will be sent to members of the Corporation's staff abroad and to any readers of the REVIEW who indicate their wish to receive a copy; requests should be received not later than the end of the year.

* It is of interest to note that types of cotton that flower very rapidly apparently attract cotton stainers to a greater extent than those that flower more leisurely.

flowers early and rapidly like the American, it too will be agriculturally unsatisfactory. The question is, why should early and rapid flowering be correlated with a poor development of the root system? This problem, like that of "running to bush" cannot, we believe, be profitably attacked until more is known about the fundamental laws governing the transport about the plant of nutritive substances, especially sugar and nitrogen compounds.

3. *The Condensation of Sugar to form Cellulose in the Lint Hair.*—A number of questions arise here. What, for instance, are the causes that prevent the deposition of cellulose upon the wall, which normally goes on in the lint hair, and thickens it into a real fibre? The importance of this question lies in the fact that the unthickened hair is extremely liable to give rise to a nep. The cellulose of the wall is formed from the sugar that is brought from elsewhere in the plant, and may roughly be regarded as merely a condensed form of sugar. The amount of thickening that can go on will thus be ultimately determined by the supply of sugar to the boll. Or, again, consider the great seasonal variation in ginning percentage. What is it that decides how sugar is apportioned between the seed and the seed hair? for it is this that really determines ginning percentage. These questions are thus again parts of the general problem of the transport of sugar about the plant, and the causes that determine how it is allotted to different parts of the plant and of the boll.

All these special problems that we have been considering, therefore, thus depend for their proper solution upon an elucidation of the wider underlying problem of the transport of nutritive substances about the plant, and their local distribution to the leaves, roots, flowers, seeds, lint hairs, and other parts of which it is made up. It seemed to us, therefore, that an attempt to deal with this general problem was the most hopeful line of attack upon the others already mentioned which are of such great practical importance to growers and users of cotton.

About this general problem, although one of the first importance, comparatively little is at present known, and the difficulties in the way of a solution are considerable. Even a question so apparently simple as whether the main channel of transport in the stem is located in the wood or in the bark is still a matter of some uncertainty. We therefore set to work to find out a little more regarding the machinery by which sugar is transferred from one part of the plant to another, and the factors determining the rate and direction of movement. (*Empire Cotton Growing Review*, Vol. IV No. 4).

(*To be continued.*)

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

COTTON GENETICS.

By S. C. Harland,
Geneticist, Cotton Research Station, Trinidad.

The science of genetics deals with the way that characters are inherited in both plants and animals. It is only within the last thirty years that the laws of inheritance have been formulated, but an enormous body of information is being rapidly accumulated on the manner in which characters are inherited in such diverse material as fruit-flies, sheep, mosses, maize, barley, and snails. It has now been shown that although each species of plant or animal has its own special characters, the mode of inheritance of such characters is governed by the same laws. Thus the presence and absence of wax on the stem of the castor-oil plant is inherited in the same manner as the presence and absence of brown pigment in the eyes of human beings, or the presence and absence of red colour in the leaves of cotton. The general aim of genetic studies of the cotton plant is to identify the unit characters found in the genus as a whole, elucidate their mode of inheritance, and apply the knowledge thus gained in the synthetis of new and better varieties than those now grown. If it became necessary to produce a new American cotton with brown staple, red leaves, and yellow flowers, it could easily be done because we know the exact mode of inheritance of each of these characters. But if we were asked to produce a new variety of American cotton with staple exactly like that of Sakel Egyptian, we should have to confess that we do not at present even know whether it is possible. Most cotton-breeders declare that it is not possible to breed such a cotton, but reliable statistical evidence is lacking. It is thus necessary to define the limits to which the synthesis of new types possessing any desired combination of economic characters can be carried.

The genus *Gossypium*, to which cotton belongs, exists in an enormous number of varieties and species. Some of the species have only been seen in a wild state, and nothing is at present known of their agricultural behaviour or economic possibilities. There is a huge and practically unexplored field in the genus *Gossypium* which has never been exploited, and one of our first tasks was to get together as complete a collection as possible of every species and variety of cotton from all over the world, and to begin an accurate study of their measureable characters, and of their taxonomic and genetic relationships. In this way the greatest possible advantage will be taken of the wide variability existing in the genus. Among the interesting types in our collection are: *G. tomentosum*, *G. Stocksii*, *G. Davidsonii*, and *G. Sturtii*, wild cottons from Polynesia, India, Lower California, and Australia respectively. We also have cottons from Turkestan, China, Burma, Nyasaland, New Guinea, Peru, Ecuador, and Guatemala, besides an exceptionally complete collection of commercial Upland, Sea Island, and Indian varieties.

Ordinary commercial varieties may be divided into two main groups: the New World group, comprising Upland, Sea Island, Egyptian, and Peruvian; and the Old World group, which include all the Indian types except the acclimatized Uplands, and some cottons from China, Korea, Japan, Burma, Afghanistan, and Africa. There is a great taxonomic gulf between these two groups, which represent the two fundamental divisions into which the genus *Gossypium* is divided. The New World cottons are capable of producing long and fine staple, and include the best of the commercial cottons. The Old World cottons usually produce short and coarse staple, which can be spun only into very low counts. They are, however, exceedingly hardy, and will grow under climatic conditions which New World cottons will not tolerate. They are said to be resistant to drought, and to certain insect pests such as the Pink Bollworm. Only their low yield and poor staple prevents them from replacing Upland cotton over large areas, and we are investigating the possibility of improving the yield by developing a large boll on the staple by hybridization. We have obtained certain types of Old World cotton from Upper Burma with exceptionally long and silky staple fully equal to good American. By crossing the Burma cotton with a heavy yielding type from China, known as the "Million Dollar" cotton, we have obtained some new long-staple Asiatic hybrids which have great merit, and which we hope will be ready for ginning tests in two years' time. Conceivably we may produce a new type of Old World cotton which may replace most of the American cotton in sub-tropical Africa. It should be mentioned that although hybridization is readily performed within the limits of each group, it is practically impossible to cross Old World with New World cottons, and even where successful the hybrids are completely sterile.

The breeding of disease-resistant cottons has also very great possibilities. Egyptian cotton in particular is very susceptible to the Black Arm disease, which does a tremendous amount of damage in districts of high atmospheric humidity. Under the heavy rainfall of St. Vincent, some almost immune strains of Sea Island were isolated between 1915 and 1919, and these are being crossed with Egyptian varieties with the idea of building up a collection of resistant types for distribution in various parts of the world.

Although the work of the Department is primarily concerned with the purely scientific aspect of heredity in cotton, we consider that certain defects in commercial cottons can be partly eliminated, even with our present knowledge. An important problem is the cause and cure of neppy cotton. Certain types of Empire cotton are said to be neppy, and the same complaint is made about some Egyptian varieties. It is perhaps not too much to say that "neps" are one of the greatest sources of annoyance in the cotton trade, not only to the spinner but also to the finisher. All Egyptian varieties are not equally liable to produce neps: Sakel is said to be a neppy cotton, while the old Jannovitch cotton, now no longer grown in a pure state, was said to be particularly free from this defect. This indicates that the tendency to produce neps is partly an hereditary defect, and the way is thus opened to the elimination of one cause at least. We have made the interesting discovery that there are certain Mendelian factors which can cause the death of seeds inside the boll when they are partly developed, and when the lint on them, though of full length, has little or no secondary thickening. Cotton from these dead seeds produces neps when spun, and even if present to a small extent would give the spinner much trouble. We have established clearly that cottons differ very considerably in the proportion of dead seeds which they exhibit, some American-Egyptians showing 25 or 30 per cent., while selected types grown under proper environmental conditions, are almost free from the serious defect. Aggregations of thin-walled hairs, collectively known as weak fibre, are, of course, also produced by bad environmental conditions, such as too much or too little water, or through the death of seeds by competition for nutrients, by insect attack, or by boll diseases. The breeding of American and Egyptian cottons free from an hereditary tendency to produce neps is not only important from the spinner's point of view, but is also agriculturally important because every dead seed is a loss also to the grower by reason of the diminution of the weight of the lint which it bears.

It is necessary to explain why studies of such seemingly unimportant characters as the colour of the flower or pollen are of value. It has been found that economic qualities are often associated or linked with minor structural features. Thus white-flowered beans are notoriously more delicate than coloured varieties, and in cotton the colour of the flower or pollen may be linked with some deep-seated property of the staple, which is difficult to analyse by itself. We have observed that certain white-flowered rogues in Sea Island cotton are always characterized by shorter and coarser staple than the normal yellow-flowered type. Generally speaking, white flowers in a Sea Island crop are always borne on inferior plants, and should be eliminated wherever seen. There seems to be a linkage between pollen colour and boll loculus number—a character which bears on yield. Flower colour is probably linked with one of the factors for hairiness, and the latter character is important owing to its connection with resistance to jassids and aphides. As work proceeds, we hope to bring to light many more of these linkages.

There has been much discussion in cotton literature during recent years on the question of pure lines. We are of the opinion that with the possible exception of some of the St. Vincent and Montserrat Sea Islands, which have been self-fertilized for at least ten generations, no commercial cottons yet merit the name of pure

line—*i.e.*: a strain in which all plants have identical hereditary factors. It is extremely difficult to demonstrate the purity of a strain, for it may be segregating in factors which are not capable of measurement. Some of the West Indian natives have never been observed to deviate from type, and as they have been naturally self-fertilized for probably fifty generations, it is probable that they are the purest known cottons. In the Sea Island cottons above-mentioned rogue plants occur fairly frequently, and in such proportions that they cannot be regarded as ordinary Mendelian segregates, but are most probably mutations. We are now able to recognize the main types. One, the Crinkled Dwarf, was described by the writer in 1916, and shown to be a simple Mendelian recessive. It was not observed again till 1925, when it appeared in a pure line in St. Vincent. In 1927 it appeared as one plant in a two-acre field in a field of uniform Sea Island cotton in Trinidad. This type is certainly a mutation. Another type is the white-flowered type bearing poor staple. This is also a recessive mutant, as revealed by its behaviour when crossed with the normal type. Other rogues are characterized by sterility on either the male or female sides or both, but their relationship to the normal type is not yet known.

It is possible that the appearance of aberrant forms is due to the release of recessives from strong linkage by rare cross-overs, but it will be seen that it is important from an agricultural point of view to know whether it is really possible to get pure lines. If it is possible, the line will breed absolutely true for an infinite number of generations if protected from natural crossing. But if, as we suspect, the tendency to produce rogue plants as recessive mutants with undesirable agricultural or industrial properties is a natural one, and inherent to the genus, it will become necessary constantly to renew the seed from a pure source, and to watch for the occurrence of inferior types. Otherwise the purest type may show serious degeneration in a few years. The whole question is being followed out in great detail, and it is hoped to review the situation at an early date.

On the purely scientific side, inheritance studies are being made of the following characters: colour of flower and pollen, petal spot, leaf colour and shape, male sterility, chlorophyll deficiencies, hairiness, seed-fuzz, and various lint characters. Particular attention is being paid to characters which are common to both the Old and New World groups. The former have thirteen pairs of chromosomes, while the latter have twenty-six pairs. On the hypothesis that hereditary factors, or genes, are located in the chromosomes, it is possible that comparative studies of inheritance in the two groups will afford some information on the method of evolution within the genus. So far we can say that the mode of inheritance of most characters seems to be much less complicated in the Old World cottons. Flower colour, for example, in this group appears to be conditioned by three pairs of factors, and the various shades of colour are comparatively easily distinguished. In the New World group we have so far identified one pair of factors with an unknown number of modifying genes tending to intensify or diminish the amount of colour in the flowers. Thus, while it is easy to classify segregating populations into yellow and cream, the colour gradations in the yellows are so subtle as to defy classification. Inheritance in New World cottons is usually complicated by modifying factors, and this is probably due to the greater number of chromosomes, which has in the past provided a greater opportunity for modificatory mutations to occur. Mutations appear to occur less frequently in Old World cottons, only one case having so far been recorded.

The cotton plant does not appear to differ from other plants in the way its characters are inherited, though Mendelian analysis is difficult. Considerable distortion of the usual Mendelian ratios often occurs, partly through the operation of lethal factors which kill certain zygotic combinations, and probably to some extent through differential pollen-tube growth. There is, however, every reason to believe that in a comparatively short time the mode of inheritance of many characters will be elucidated. (*Empire Cotton Growing Review*, Vol. IV No. 4)

CO-OPERATIVE MARKETING.

Annual Report of the Cocoa Planters' Association of Trinidad.

The Directors of the Cocoa Planters' Association of Trinidad, Ltd., record in their report to 30th June, 1927, another year's successful working. The Association consists of cacao planters who co-operatively market the whole of the produce from their estates (1). A drought during the first half of 1926 caused extensive damage among the cacao plantations, resulting in reduced exports. Several cacao areas have been replaced by sugar-cane. The Cocoa Planters' Association exported 38,894 bags (165 lb. each) of cacao, compared with 47,418 bags during the previous year. The average price amounted to $15.43 (2) per fanega (110 lb.), from which were deducted 14 cents per fanega for working expenses, and 4 cents a fanega for the Deferred Deposit Fund which now stands at $34,726.17. Usually the United States of America takes approximately 50 per cent. of the Association's exports, but this year less than 11,000 bags were sent to this country owing to brisker buying in the United Kingdom and on the Continent. The registered membership on 1st July, 1926, represented 187 estates. During the year three members were excluded, three resigned, and six automatically ceased to be members on account of the sale of their estates. Thirty new members were added during this period and others have subsequently joined.

C.Y.S.

(1) See *Tropical Agriculture* Vol. II, No. 12, pp. 289-291.
(2) $1,00=4*s*, 2*d*.

THE PRINCIPAL'S REPORT, 1926–27.

Copies of the Prospectus for 1928-29, the Principal's Report for 1926-27 and the Register of the Imperial College of Tropical Agriculture may be obtained on application from the Secretary, Imperial College of Tropical Agriculture, 14, Trinity Square, London, E.C.3, or from the Registrar, Imperial College of Tropical Agriculture, Trinidad, B.W.I. For the convenience of readers extracts from the Principal's Report for 1926-27 are published below.

MR. G. EVANS, who was appointed Principal in July, 1927, begins his Report with a tribute to Dr. Martin Leake whose devotion to College interests was well known, "under his able management, this institution has made very rapid progress, and it is largely due to his energy and foresight that it has reached its present satisfactory position."

A new appointment during the year was that of Commissioner of Agriculture and Professor Ballou was offered and accepted this post.

The following additions and changes in the staff also occurred. Mr. A. L. Baker and Mr. G. Wright were appointed lecturers in Agriculture and Economics respectively. Mr. R. E. Hunter was appointed lecturer in Botany in place of Mr. E. E. Cheesman, who was made Professor of Botany. Mr. H. H. Croucher was appointed lecturer in Chemistry in place of Mr. P. E. Turner, who was seconded for special research in connection with the Froghopper Investigation Committee. Mr. R. Follett-Smith, who was also employed by that Committee for research, maintained his headquarters at the College.

Professor W. Scott continued as head of the Department of Sugar Technology by arrangement with the Manager of the Usine Ste. Madeleine. Mr. D. McAllister was Assistant Technologist directly in charge of the Sugar Factory for six months from December to June. Dr. R. H. Hurst was appointed Sugar Chemist.

The opening of the Milner Hostel has necessitated one or two changes. Dr. H. R. Briton-Jones was invited and agreed to perform the duties of Dean of the College in addition to his other work, and Mr. Corbin was appointed Manager of the Hostel while continuing his duties as Accountant. The Accountant's branch was strengthened by the recruitment of Mr. J. H. Aikman as Assistant Accountant.

At the beginning of the Academic year there were sixteen Diploma students and twenty-four Post Graduates in residence. In addition, two officers of the Gold Coast Agricultural Service attended a "refresher" course and the Indian Central Cotton Committee also sent a student, while the Agricultural Superintendent of St. Lucia attended for a few weeks for special work. Emphasis is laid upon the value of the College as a means of giving "refresher" courses to officers of Agricultural Departments in the more tropical parts of the Empire. This innovation has been welcomed by the Staff and it is a movement that it is hoped will be developed. Such officers who do attend are given an opportunity of getting up-to-date and into touch with the latest scientific developments and, from the College point of view, with the students, to whom they can impart their knowledge of conditions of life and service in the tropics.

The Associateship was awarded to the following students during the year :—

1924-25.

James Erskine Peat, B.Sc.
William Carstairs Lester-Smith, B.Sc.

1926-27.

Douglas William Hughes Baker, B.Sc. (Agr.).
Philip Alan Bowmaker, B.Sc. (Agr.).
J. Allan Craig, C.D.A. (Hons.), N.D.A.
John Gardiner Davies.
Samuel James Felix Dias
Philip Kennedy Findlay, D.I.C., B.Sc.
William Victor Harris, B.Sc. (Agr.).
Kenneth Townend Hartley, B.A.
Cedric Harvey, B.Sc. (Agr.).
Reginald Grosvenor Heath, B.Sc., (Agr.).
Harold Kendall Hewison (Supt. Agric., Ashanti).
Donald McDonald, B.Sc. (Agr.).
Jan Leendert Moerdyk, B.Sc. (Agr.).
Harold Musk.
Cyril Leonard Newman, B.Sc. (Agr.).
Victor Frederick Orlando Olivier, B.Sc.
Thomas Daniel Rutter, B.Sc. (Lond.) (Agric.).
Harman Benjamin Springer.
Lawford Hugh Anderton Stone, B.Sc.
John Elwy Symond (Supt. of Sisal Pln., Accra).
Trevor Lloyd Williams, B.A.

Research and Investigation.

Since the arrival of additional staff it has been found possible to extend somewhat the research programme, and good progress has been made during last year. The main crops on which investigation has commenced are the following :—

Bananas.—Acting on the recommendations of Dr. A. W. Hill, which were incorporated in the fruit report of the Imperial Economic Committee, the Empire Marketing Board agreed to give a recurring grant of £2,000 for five years and a capital sum of £2,350 to provide the necessary buildings and equipment for Banana Research. Plans for the buildings necessary for carrying out detailed cold storage experiments are now being considered, and steps will be taken to recruit the additional scientific staff provided for. Trials with immune varieties have been continued on a field scale, and in addition to the Governor and the Giant Fig, which have continued to yield heavily and exhibit immunity to the Panama disease, two other varieties, Lacatan and Bumelian have come into prominence, and their cultivation will be extended. Unfortunately these varieties are not entirely suitable for the present methods of transport on a commercial scale, and cold storage and packing experiments will have to be

carried out with them. The Botanical section has continued to keep existing varieties and hybrids under careful observation. The hybrids raised between Gros Michel and a wild type, known as GM × B2, have continued to show immunity. The fruit is of excellent flavour but the fruit and bunches are on the small side, and it is intended to back cross with Gros Michel in order to try and remedy these defects. The problem is also being tackled in another direction by crossing two varieties of the Cavendish type. These are immune, but are not good travellers under existing commercial conditions, but it is believed that hybrids between such varieties as Giant Fig and the Governor with the Congo may give types of greater commercial value. Over forty healthy seedlings are at present growing. The cytological side of this work is now being resumed.

Sugar.—This crop is receiving more detailed attention from the investigators at the College than any other crop.

A start has been made in the genetics of cane and a family of 300 seedlings of self-fertilised arrows of B.H. (10) 12 have been planted out for study. This line of investigation is a most important one, as there are many problems that are at present perplexing cane breeders in other parts of the world, which it is hoped may be cleared up, and the work may lead eventually to a simplification and speeding up of the regular cane breeders' methods. This line of work is, in my opinion, definitely within the scope of an institution such as this, as it involves pure research work.

In the field a series of standard varieties of seedlings have been grown, and an estimate of their value from the field and factory point of view has been undertaken, the Agricultural and Sugar Technology departments co-operating to get these results.

The intimate interest that the College has taken in the Froghopper blight problem has resulted in a great deal of the time of the Chemical section being taken up with cane problems, more especially in connexion with an investigation into the cane soils and insecticides.

The Principal is a member of the General Committee, and the Professor of Chemistry (Mr. F. Hardy) has been made Chairman of the Scientific Committee, two other members of the College staff being also members. Definite progress has been made, and as a result of a careful soil survey and of numerous soil analyses, including the P.H. values by the most recent methods, the opinion has been expressed that there is a definite connexion between the lime content of the soil and the incidence of blight. Extensive trials this season also lead us to hope that in cyanogas, when intelligently applied, the planter has now a definite means of checking the pest in its early stages and curtailing damage. Investigation will have to be continued for some time longer before the problem is completely and satisfactorily cleared up.

Cyanogas may prove a useful palliative, but it is necessary to get at the fundamental cause, and this will entail continued investigation on the lines that appear to have been successfully initiated during the past year.

The Sugar Technologist and the staff carried out several important investigations into the processes concerned with the clarification of raw juice and the crystallisation of sugar in the vacuum pan. Research was also conducted into the elimination of certain non-sugars during clarification and concentration from mixed juice, clarified juice, and syrup, and the results obtained, which are of considerable interest, have been published.

Further experiments were made on the loss in weight of cane by evaporation and the effect of cane top on the recovery. A special sugar number of *Tropical Agriculture* was published in August, and the results of these experiments are discussed therein.

Cacao.—An investigation into the fertilisation and embryogeny of cacao has been completed and the results published by the Professor of Botany. The Professor of Economics has made an economic survey of the cacao industry of Trinidad, and this has also been published.

Cotton.—Research into the genetics and physiology of this crop has now been left to the Empire Cotton Growing Corporation's Research Station which is situated close to the College. The Mycologist has, however, made an investigation into certain forms of root rot on cotton caused by fungi of the genus Rhizoctonia.

Tobacco.—The work of raising strains of improved kinds of heavy manufacturing types has been continued, and in spite of the exceptionally inclement weather useful progress has been made and two strains in particular are promising. What is urgently needed at the present time is a flue for curing, and it is hoped to obtain funds for this purpose during the coming year.

Citrus.—The extensive outbreak of Withertip disease in St. Lucia has again brought this crop into prominence. The Mycologist has investigated the outbreak in this and other islands, and has also made an inquiry into an outbreak of obscure disease known as "Red root" in Dominica. No progress in the raising of immune varieties is possible at the College at the present time owing to shortage of staff and funds, and it is possible, in the light of this year's experience, that this method may not prove to be the best means of solving the problem.

Jute.—Trials were made with different varieties of jute, and the results have been published in *Tropical Agriculture.* There seems little doubt that satisfactory yields, particularly of the "olitorius" variety, can be obtained in Trinidad, but it seems probable that economic conditions render it unlikely that it can be introduced on a commercial scale. Further trials will be made this year.

(*To be continued.*)

LOW PRICES FOR COTTON.

AGRICULTURAL production is subject to a number of unpredictable influences such as climate and pests which affect the yields per acre and the total production of the crop. On these two results, the economic outlook for the particular crop and the prosperity of the grower depend. The suggestion that stability of price would be a good thing for both grower and manufacturer has of late years gained increasing acceptance, and cases have been referred to in which crop prices have been reasonably stabilised with beneficial results.

We reprint below portion of an article published in the first quarter of 1927, which refers to stabilisation in the production of cotton. Much of the argument is applicable to other crops.

The impression is widespread that such a vast production of cotton as has just occurred should be productive of unmitigated good to all concerned, as indeed ought to be the case were our systems of supply and distribution, with the necessary co-operation, ideally organised. It is something of a satire upon present conditions that such a gratifying result will not occur, but that much trouble and distress will be caused, though a great amount of extra wealth has been created.

The one who will principally suffer, the grower of the cotton, is the one who ought in justice to profit most. He has been unusually successful in the primary object of a cultivator, the production of the largest possible crop at the least possible cost; yet he will be severely punished for his success. Production in excess of the actual demand involves a fall in price that more than wipes out any extra profit that ought to accrue to the growers, and in many cases may involve them in actual financial loss. Yet the grower is in general a poor man, living from hand to mouth.

Even to the spinner and the manufacturer this sudden lowering of price is by no means an unmixed blessing. Already one reads of the Bombay mills reducing output on account of the low prices and the heavy stocks on hand. The cotton is not sold in its finished condition as soon as bought, but undergoes various treatments lasting over a period of some months, so that when it is actually placed upon the market its economic selling price may stand in no necessary relation whatever to the price of raw cotton at that particular time. Goods now being sold, for example, were made from cotton purchased at 10*d.* or over.

What the manufacturer desires above all things is a *stable* price for raw cotton. We should be inclined to consider the price as stable when it did not, in any one year, rise or fall more than, say, 5 to 7 per cent. above or below the average price for that year. (It might, of course, be always rising, or always falling, over longer periods of one or more years.) To put it in other words, if the year's average for American middling were (say) 8*d.*, the price might vary between 7½*d.* and 8½d. Greater stability than this could hardly be expected, with a crop so liable to pests and diseases.

The manufacturer enters into contracts running over many months, and it is essential to their satisfactory fulfilment and to ease and freedom in working, that the price of cotton should not vary to any serious extent during these periods, which are being commenced upon every day of the year. The manufacturer may be able to obtain some protection from the futures market, but this is only a partial cover, whose value becomes steadily less the further the cotton diverges in quality from middling American.

Naturally also the manufacturer desires that the price shall be as low as is possible with the assurance of stability, for low prices stimulate demand for the goods that he has to sell, and are good for trade. But sixpenny cotton without stability of price is not so good from his point of view as sevenpenny, or even eightpenny, with stability. And it is in this fact that there lies the possibility of satisfying both the manufacturer and the grower.

Lastly, it must be remembered that the spinner and the manufacturer are equipped, at great expenditure of capital, for dealing each with a certain type of cotton, and cannot readily turn to another type, or to another fibre, or to the manufacture of something else, whereas the grower, should he find cotton unsatisfactory, can frequently find some other product to cultivate —ground-nuts, for example. Cotton is an annual crop, and the ground is free at the end of the season.

The growers of cotton, on the other hand, naturally desire to obtain the highest price possible, and perhaps regard stability, though in itself very desirable, as of less importance. Too high a price defeats itself by tempting too many into the production of cotton. The average world price must evidently be that which in an average year will bring forward just about the right amount of cotton to satisfy the demands of the spinners, the differences that arise within a period of one or two years being smoothed over by the existence of the "carry-over" stock of cotton. As the actual production of the cotton is in the hands of the growers, the price must evidently be one which is not too low to satisfy them. It must bear such a relation to the prices obtainable for other possible crops as to induce the right number of growers to cultivate the right area in cotton. A great rise will induce too many to come in, a great fall will drive the growers to try something else, for their proceedings are governed not by sentiment so much as by finance.

The present low price may give the much-needed stimulus to trade in cotton products, which has long been rather depressed, with short time for many of the workers; but it is practically certain to cause a restriction of area in the coming season, especially in regions where the growers have some other crop to which they can turn.

Many different panaceas, to which we shall presently come, are under consideration at present, having in view the amelioration of the position of the grower in regard to the present bumper crop. The spinner and the manufacturer must be prepared to realise that the present very low price is hardly likely to continue. They should take the long view, and should aim at greater stability of prices, with the least rise in general price that will allow of the cultivation of sufficient cotton to meet their demand. They must also remember that though Empire cultivation is rapidly increasing, it will be a long time yet before we can do without the American supply, and therefore, it is the American grower who must chiefly be satisfied at the present time. The sudden removal from the market of American-grown cotton would completely upset the whole trade.

We must now go on to consider how best to attain this highly desirable aim of stability in price, and at the same time we may consider the probable effect upon Empire cultivation of the present low prices, the two questions being closely interwoven, and the encouragement of Empire cultivation the chief end in view.

For the last sixty years the production of "bread-and-butter" cotton has been a practical monopoly of the United States of North America, and one which has not been seriously abused, though subject to the inevitable disadvantages of monopolies. One of the chief of these is that cultivation in one country only must render the crop liable to great variation, for in general the whole crop will be more or less subject to similar conditions of climate, pests, labour troubles, &c. Nearly a quarter of a century ago these facts so strongly impressed a number of far-sighted men that they founded the British Cotton Growing Association to encourage the cultivation of cotton in the wonderful variety of countries, climates, and conditions that may be found within the British Empire. After many years of hard work, their foresight is now in a fair way to be crowned with full success; the cultivation of cotton in the Empire is at length assuming considerable proportions.

Monopoly of a crop by one country cannot be considered as a good thing, for many reasons; but "single crop" cultivation is equally little to be desired, and both should be done away with so far as is practicable, the one by extension of cultivation into different countries, the other by the introduction of variety and rotation of crops. The full carrying out of both these programmes seems to us the one really satisfactory way at present open of achieving the great end in view, that of the stabilization of the price of cotton at the lowest possible figure. So long as cultivation is confined to one country, so long will a bumper crop tend to be followed by undue restriction of area, with its corresponding undue rise of price; and so long as any other country depends almost entirely upon cotton for its income so long will that country be in an unstable financial condition, and liable to violent fluctuations in prosperity. Extension of cultivation and variety and rotation of crops are equally called for.

Extension must be into countries with as much difference in climate and other conditions as may be practicable. So great is the variety within the Empire that there may some day be little need to look outside of it, as already it produces almost every kind and quality of cotton that is known. The chief lack is that of a suitable climate in the north temperate regions and this is already supplied in full measure by the United States, which will probably long remain the chief producer of cotton. In the present condition of the cotton market, when the coming season is almost certain to be marked by a considerable restriction of area and rise of price, the more that the cultivation of cotton within the Empire can be extended, the better for the great aim of stabilization of the price.

But extension of cultivation is not enough. In some countries cotton is the only, or the principal string to the financial bow, and this is also an unsound position. Cotton should not be the only crop, but should be supplemented by others, and if in a regular "rotation of crops" this will be all to the good, helping to stabilize the production of cotton in that country, reducing the liability to pests and diseases, rendering the peasantry less liable to the troubles of fluctuation of price, gaining the advantages of rotation, making the revenue of the Government more stable, and so on.

The grower will be hard hit by the present low prices, and in view of the fact that the bulk of the growers are still within the United States, the rise of price that is practically certain to follow will have to be enough to satisfy them—say perhaps 2*d*. or 2½*d*.—bringing the price of American middling to say 8½*d*. or even 9*d*. But though we may have to allow the price in the near future, to reach such a figure, there is no reason why we should endeavour to stabilize it quite so high, for we have every right to suppose that a large part of the Empire growers can produce cotton profitably at a lower rate. The price of most of our cotton is at least 1*d*., sometimes 2*d*., above that of American middling, while the cultivation, within the tropics at any rate, is usually a "family" affair, each family cultivating a small area, and doing the whole of the cultivation and picking themselves. Under such circumstances the return obtained for the crop, less the cost of the seed, &c., is looked upon as profit, and the actual cost of production is very small. The plantation industry of cotton will be very hard hit by the low prices, but the village industry should survive, even though the cultivators would be sadly puzzled to know why the price should have fallen so greatly from the halcyon days when they provided themselves with so many luxuries.—(*Empire Cotton Growing Review*, Vol. IV, pp. 1-9).

(*To be continued.*)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Effect of Sulphate of Ammonia on Reaction of Cane Soils.

It is generally believed that sulphate of ammonia applied to soil as fertilizer, tends to make the soil more acidic in reaction. In order to test this idea, Dr. O. Arrhenius has examined the effect of continuous fertilization with sulphate of ammonia on the sugar-cane soils of Java (*Arch. Suikerind*, 35, 1927, pp. 939-941).

The opinion that plants take up the basic part of ammonium sulphate and leave the acid part behind in the soil, is erroneous. Modern teaching describes the fate of ammonium sulphate in somewhat different terms. In the presence of adequate amounts of lime (calcium carbonate or bicarbonate), sulphate of ammonia forms ammonium carbonate and calcium sulphate through mutual interaction. The ammonium carbonate is then oxidized in the presence of lime to calcium nitrate and carbonic acid. Nitrifying bacteria hasten and control this process in the soil. The carbonic acid furthermore combines with lime to form calcium bicarbonate, so that, provided always there is some free lime in the soil, no acid need accumulate at all. Nevertheless, soil leaching may gradually remove the calcium sulphate formed in the first stage of the process, and the soil may eventually be deprived of its store of lime, and of calcium combined or "absorbed" at the surface of the soil particles. Leaching thus plays the chief rôle in the chain of circumstances that results in the loss of lime in soils, and it is seen that fertilization with ammonium sulphate merely enhances the *rate* of loss.

Unless a soil is entirely devoid of free lime and of combined calcium, the effect of ammonium sulphate applications on soil reaction is likely not to be very marked. Lime-free soils are, of course, usually highly acidic initially, so that ammonium sulphate applications only aggravate the condition, and are not primarily responsible for it.

At Rothamsted, annually applications of ammonium sulphate for 46 years have changed the reaction of the soil from pH 5·8 to pH 4·5, but doubtless leaching alone has been responsible for most of this change, for no lime was added to the Rothamsted soil during the whole of the 46 years period.

Laboratory experiments with acidic soils have demonstrated, however, that addition of increasing amounts of ammonium sulphate has proportionately increased, through a base exchange process, the acidity of soil contained in pots or tanks, but the additions which were found necessary to alter appreciably the soil reaction were very much larger than those which would be applied under practical field conditions.

In Java, actual plot tests proved that ammonium sulphate gave significant increases in yield of sugar-cane, no matter what the original soil reaction. Similar experience has been obtained in Trinidad cane lands, many of which are highly acidic in reaction, and yet markedly respond to applications of sulphate of ammonia.

It is only when ammonium sulphate is applied in very large doses, or is applied in smaller doses over a great number of years to soil which is initially very dificient in lime, and which receives no lime in the interium period, that appreciable increases in acidity may be expected. Finally, acidity increase under these circumstances is least when the soil contains an abundance of clayey matter or of organic humus.

* * *

New Fungicidal Dusts.

In *Industrial and Engineering Chemistry* for January, 1928, Drs. Atherton Lee and J. P. Martin, of the Hawaiian Sugar Planters' Association's Experiment Station, describe some new dusts, containing sulphur mixed with certain oxidizing agents. These dusts proved to be very effective against the organism responsible for the "eyespot" disease of sugar-cane (*Helminthosporium*).

Ordinary powdered sulphur, Bordeaux dust, and organic mercury dusts, have been found not to be of much value for combatting this particular disease. By mixing powdered potassium permanganate (1 per cent) with sulphur, it was discovered that the efficacy of the sulphur as fungicide was increased nearly 300 per cent. By using greater proportions of potassuim permanganate up to 5 per cent., further increase in efficiency was attained, but a greater increase in concentration of oxidizing agent beyond this figure, gave no further benefit.

Unfortunately, the use of the new oxidized-sulphur dust in cane fields in Hawaii, has not yet proved an economic plantation practice. In many localities the rainfall is apparently too high to allow the material to exert its best effect. Nevertheless, the new fungicide may be serviceable in other places and for other plant diseases.

* * *

Sunn Hemp Root Nodules.

In the *Annals of Applied Biology* for 1926 (Vol. XIII, pp. 244-249), Dr. Gangulee describes the life history and conditions favouring development of the nodule bacteria of the Sunn Hemp (*Crotalaria juncea*). Sunn Hemp is a leguminous cover crop which is receiving increasing attention in tropical countries, and any information regarding its requirements is bound to be of great importance.

Dr. Gangulee found that the special nodule bacteria of Sunn Hemp pass through a cycle of morphological changes very similar to those observed by the Rothamsted workers in the case of other nodule organisms. He found that nodule formation in Sunn Hemp is favoured by high soil moisture content, by high soil porosity, and by neutral or slightly alkaline soil reactions.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Starch in Canes.

De Sornay gives (in *Revue Agricole de Maurice*, No. 32) some conclusions of Haddon on the starch observed in certain canes: Starch is formed in all Uba canes in acid soils; stalks growing on alkaline soils show no traces of starch; stalks containing no starch, after vegetating during three weeks in an acid solution of 0·5 grms. of SO_2 per litre, formed starch; Manganese does not prevent the formation of starch but increases the purity of the juices by 5 points, at least. When acid soils are limed, the formation of starch in the canes is more or less prevented. It was found that most raw South-African sugars contained starch, an impurity of the juice of Uba canes.—*Sugar*, Vol. XXIX, No. 8, p. 370.

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The Nature of Molasses

In a study of this question Dédek arrives at the following conclusions: The inability of beet molasses to crystallise is not due to colloids or to viscosity. The molasses forms a stable system with definite solubility relations. Crystallisation experiments with mixed solutions of sucrose and salts indicate that there is no need to assume the existence of actual chemical compounds formed by these substances. Artificial solutions and technical molasses stop crystallisation at an equimolecular relation of sucrose and Na plus K, and this relation is the only reliable indication of a completely exhausted molasses. Cane molasses resembles beet molasses but is less thoroughly exhausted. In practice the organic salts of Na and K appear to be the most important melassigenic substances. The degree of exhaustion of molasses can be judged by the relation between the sucrose and Na and K. The criterion of all epuration processes is their ability to eliminate to sodium and potassium salts.

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By-products.

In the utilization of the by-products of cane sugar manufacture, two distinguishing accomplishments stand out during the past twenty-five years. The first of these is the production of the motor fuel "Natalite" (so-called from its having been first produced in Natal) which is made by the fermentation of sugar house molasses into alcohol. The latter, in order to be employed in the ordinary gasoline engine, requires to be enriched with a liquid fuel of lower volatilization point and ethyl ether, which can be manufactured directly from alcohol by treatment with sulphuric acid, has been found to be suitable for this purpose. The oxidation of alcohol to acetic and other acids will produce pitting or corrosion of the engine unless a slight amount of ammonia, pyridine, or other organic base be added to neutralize the acid products of combustion. Natalite, as manufactured by various formulas, consists of:

Ethyl alcohol (95 per cent.), 54 to 60 per cent.
Ethyl ether, 45·8 to 39 per cent.
Ammonia, pyridine, trimethylamine, &c., 0·2 to 1 per cent.

A report upon the manufacture of industrial alcohol in Hawaii places the cost at 8 to 11c. per gallon, omitting the value of the molasses as a raw material. Each ton of raw sugar is accompanied by the production of about 42 gallons of molasses which will yield about 15 gallons of industrial alcohol. The Hawaiian alcohol motor fuel based upon the formula of J. P. Foster, contains:

Ethyl alcohol (90 to 92 per cent.), 75·2 per cent.
Ethyl ether, 22·6 per cent.
Kerosene, 1·5 per cent.
Pyridine or aniline, 0·7 per cent.

About 1·3 gallons of alcohol is required to make 1 gallon of ether.

Another important commercial by-product of the cane sugar industry during recent years is the fibre board which is prepared from the bagasse of the cane mills. The utilization of the sugar cane bagasse for the production of paper, fibre board and other cellular materials has been suggested for many decades, but none of the processes hitherto proposed has proved successful for the reason that the profits of the enterprise did not exceed the fuel value of the bagasse. This objection has been overcome, and now the sugar planter in favourably located sections can dispose of his bagasse at a price exceeding its monetary value as a fuel.

C. A. Browne.—*Sugar*, Vol. XXIX, No. 8, p. 380.

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Microscoping Sugar Crystals.

Stimulated by the published work of Thieme on sugar boiling (now being published serially in *Facts About Sugar*), P. Honig, in conjunction with Nosek in Czecho-slovakia, has applied the microscope to the examination of the grain of massecuites. A study in the *Java Archief*, Vol. XXV (1927), pp. 693-697, deals with the following: influence of solution ("washing") of fine grain on the aspect of normal sugar crystals influence of the kind of cover steam on the regularity of the crystals and the rapidity of drying; mechanical impurities and their influence on the nascent sugar crystal.

The operation of "washing" in the vacuum pan to remove false grain is shown to have a harmful effect on the character of the grain, particularly in regard to removal of the mother liquor in the centrifugal. Covering with live steam in the centrifugals greatly roughens the crystal surfaces; saturated steam has the same action to a less degree; covering with pure syrup best preserves the good character of the grain. It is concluded that a diligent use of the microscope in pan work will provide answers to numerous questions that arise in the boiling of sugar, and point to ways of obtaining better results.—(*Facts About Sugar*, XXII, No. 35, p. 838.)

REVIEWS.

ADMINISTRATIVE REPORT OF THE DIRECTOR OF AGRICULTURE, TRINIDAD AND TOBAGO, 1926. Price 1*s.* 6*d.* pp. 42.

This report on the work of this Department is entirely written by the Director; the more usual practice of allowing each of the departmental officers to contribute his own section not being followed. The report makes interesting reading and describes the useful work that is being done in connexion with all the important crops of the islands, and should be read by all those who are concerned. Naturally, the activities of Mr. Freeman's Department are twofold, the experimental work and the extension work; for the former, four experimental stations are maintained: the St. Augustine Experimental Station, the River Estate, and the two Government Farms at Trinidad and Tobago: the difference in nomenclature is rather confusing and seems unnecessary. Of these, the Live Stock work being carried on at the Trinidad Government Farm deserves special notice both for the efficient way in which the farm is being managed, and for the great influence the stock which is kept there must ultimately have on the working and milking stock of the island, though it may be doubted whether the service fees are not fixed at a level which is too high to encourage the small peasant to take advantage of them.

The figures given as showing the recent development of the Grape Fruit Industry show that the Department foresaw the demand that was likely to arise, and the possibilities ahead, for, as long ago as 1914, it imported a number of high class varieties, with the result that in the period 1922-26, it has been in a position to issue from the Government nurseries over 16,000 budded citrus fruits, most of which were grape fruit.

There is rather a tendency in the report to quote the bare figures of experiments, without discussing them, and this is accentuated by the fact that no estimate of the reliability of the figures is given, nor, where the plots were replicated, are the individual yields recorded. It would be better in cases like this for the Director of Agriculture merely to note the general trend of each experiment, and leave the complete records for publication in a special report or Appendix. It is noted too that there are still far too many experiments conducted, without adequate replications to ensure reliability.

Finally, it is deplorable that a report dealing with the calendar year 1926, should be received in 1928, it was only signed by the Director in October, 1927.

R. C. W.

The Report contains a short paragraph on Agricultural Credit Societies which it is hoped does not pretend to be a substitute for the separate reports on this subject, the last of which was published in 1924.

C. Y. S.

PRINCIPLES OF SOIL MICROBIOLOGY by S. A. Waksman, Ballière, Tindall & Cox, London, 1927.

In this single volume of 900 pages the author has given very comprehensive treatment to the numerous problems which have already been solved in connexion with soil microbiology and points the way to unexplored fields of research. Different chapters deal fully with different kinds of bacteria and the influences of various factors on their activities, whilst other chapters give equally generous accounts of other soil organisms including fungi, algae, protozoa and other non-protozoan fauna. The classified list of references at the beginning of the book together with the bibliography in footnotes are of great value. A large section of the book is given to the treatment of the chemical activities of soil micro-organisms. The work is complete and modern and is indispensable to those scientifically trained as Agriculturists, Bio-chemists, Soil chemists and Biologists. Within its scope it certainly stands out as the finest book so far published.

H. R. B-J.

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MARKETS AND FAIRS IN ENGLAND AND WALES II —Ministry of Agriculture and Fisheries. His Majesty's Stationery Office, pp. ix, 161. Price 6*d.* net.

The series of which this is Part II was intended to supply the lack of readily available information regarding markets in England—one which was felt by the Linlithgow Committee. Part I is a functional description, and deals with Midland markets as a whole. Part II examines the market position county by county adding brief notes on a few markets of general or special interest. Part III gives a fairly full account of important markets in producing areas and consuming centres. The work as a whole provides a good reference book on livestock and produce markets in the areas under consideration.

G. W.

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ALCOHOLOMETRIC TABLES, Sir Edward Thorpe, Longmans, Green & Co., pp. 91. Price 4*s.* 6*d.*

This book contains an extension of the alcoholometric tables included in *A Dictionary of Applied Chemistry* by the same author. The same series of three tables is given but in a more elaborate and detailed form. An introductory chapter gives a historical summary of Alcoholometry. The meaning of proof strength and methods of calculating it are indicated, and the various instruments for measuring strengths of ethyl alcohol—water mixtures obtaining in European countries and the relationships of the standards involved, are briefly described. The chapter as a whole forms an interesting summary of the subject.

The tables are printed in clear, heavy type. The spacing, however, is wide and the same matter could have been included in a much more compact form without reducing its clarity.

It is a book which most laboratories will find useful.

H. H. C.

COLLEGE NEWS.

Sir Alfred P. Sherlock, Director of Messrs. Booker Bros., visited the College on 29th January.

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Mr. S. W. Lockhart, New York, one of the Directors of the Surinam Cotton, Agricultural and Trading Co., Ltd., Surinam, visited the College recently.

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At a meeting of the Trinidad Science Club held on 26th January, Mr. J. B. Hutchinson of the Cotton Research Station gave a lecture on "Recent work in Cotton Genetics."

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The Hon. A. E. Collens, F.I.C., Superintendent of Agriculture for the Leeward Islands and a Governor of the College, visited the College on Monday, 16th January and had lunch with the Principal.

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Mr. C. B. Holman Williams has been appointed Director of the Station Agronomique de la Guadeloupe. Mr. Williams, after completing the course and receiving the Diploma of the College in 1925, became Agronomist at the Guadeloupe Station, where he has been, for some months past, the Acting Director.

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The College was visited on Sunday, 15th January, by Lieut.-Colonel F. D. Behrend and Mr. Friedrich Hirschhorn. The latter is from Kimberley, South Africa, and is connected with several mining and industrial organisations in that Dominion. Both gentlemen evinced the greatest interest in the progress of the College.

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A portrait of Sir James Currie, K.B.E., C.M.G., will be found on page x. As already notified in our December issue Sir James Currie, who is Director of the Empire Cotton Growing Corporation was appointed Chairman of the Governing Body of the Imperial College of Tropical Agriculture in succession to Sir Arthur Shipley.

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Mr. G. G. Gianetti, whose appointment to the post of Sub-Editor-Librarian was notified in our last issue, arrived from England by the s.s. *Ariguani* on 14th January. Mr. Gianetti was educated at Sutton Valence School and Selwyn College, Cambridge. He passed the B.A. examination in Agriculture in 1923 and took the special Diploma in Agriculture in 1924. He then joined the Staff of the Farm Economics Branch of the Cambridge School of Agriculture, taking his M.A. in 1927.

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A welcome letter has been received from a man who was last year at the College, and who is now in temporary charge of an experimental farm in Northern Nigeria. He gives a most interesting account of the work and of the minor difficulties that are usually encountered in the more remote parts of the Tropics. Apparently his labourers have nicknamed him "serakia aiki" which being interpreted literally is "King of Work." The proud recipient incivilly remarks in his letter: "This is a most amazing title—I never thought I'd ever be called that!!" Nevertheless the untutored savage is pretty shrewd in this respect and probably the title has been thoroughly earned.

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Mr. Eugène Loumeau, Chemical Engineer of the Bowen Research Corporation, New York City, arrived at the College on the 5th January, in the capacity of Sugar Technologist for the coming crop. Mr. Loumeau, after being educated at the Royal College, Curepipe, Mauritius, was appointed Assistant Chemist to the South African Sugar Refineries, Natal. From there he proceeded to the United States of America where he obtained the B.Sc., degree in 1923 at the Audubon Sugar School in Louisiana, taking the Sugar Engineering course. He then returned to Natal as Chief Chemist to the Tongaat Sugar Company, and from there went to New York in 1926. Mr. Loumeau has travelled extensively in cane producing countries.

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Messrs. C. A. Gomez, Curator, Montserrat, and R. E. Kelsick, Agricultural Superintendent, St. Kitts arrived at the College on 13th January, for a short refresher course. The attending of these refresher courses by the officers of the Departments in the several West Indian Islands is expected to be useful in the way of creating closer contact between research at the College and the practical agriculture of the islands, as well as by providing a stimulating experience for these officers by bringing them into contact with the officers of the College and the facilities afforded by the library, laboratories and field plots at the College. Advantage is taken also of the excellent opportunities for demonstration afforded by the courtesy of the officers of the Cotton Research Station, the Trinidad Department of Agriculture, at its Experiment Stations, and Government Stock Farm, and the proprietors of the several estates visited during the course.

* * *

On Wednesday, 7th December, a large party from the College visited the Government Stock Farm. Much attention was paid to the Zebu herd because it illustrated a type with which most of the party were unfamiliar and because it was of the greatest interest to them as the best animal for hard work in hot countries. For the special purpose of milk production and under the special precautions which can be taken in a Government Institution the half-bred animal stands unsurpassed. The Stock Farm also assists the local farmer by keeping stallions and jacks at stud and the thoroughbred stallion "Golden Eaglet" was a striking testimony of the care which is bestowed on these animals in keeping them in good condition. The pig and poultry sections were also visited whilst the possibilities of the goat to the small holder were briefly outlined by Captain Metivier. The party are much indebted to the authorities for a most pleasant and instructive visit.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Up to the middle of January there was no fresh development and quiet conditions continued with values showing a tendency to move in favour of buyers. Successive quotations throughout the month of January were: Foreign 96° *c.i.f.* 13*s.*, 12*s.*6*d.*, 12*s.* 3*d.*, 12*s.*—(31st Jan.), and preferential *c.i.f.* 16*s.* 9*d.*, 16*s.* 6*d.*, 16*s.* 3*d.*, 16*s.*, 15*s.* 9*d.*—(31st Jan.). Refiners have maintained an indifferent attitude to purchases of raws. The terminal market on 12th January was, February, 16*s.* 4½*d.* business; March, 16*s.* 6*d.*; business; April, 16*s.* 8¼*d.* sellers, 16*s.* 6¾*d.* buyers May, 16*s.* 9*d.* business; June, 16*s.* 11¼*d.* sellers, 16*s.* 9¾*d.* buyers; July 17*s.* sellers, 16*s.* 10½*d.* buyers; August, 17*s.* 0¾*d.* sellers, 17*s.* buyers. On 7th January the formation of the United States Refined Sugar Institute was announced; its immediate plans call for the establishment of uniform trade practices, improved methods of distribution and the encouragement of increased consumption.

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COTTON.—On 14th January, futures business was reported as moderate with no special features apart from a fair amount of hedge selling. Mid-American stood at 10·81*d.* on 12th January. Importing this season has been comparatively small and well behind last year. United States cotton exports to Great Britain to date total about 594,000 bales, against 1,516,000 bales at the same time last year. The stock of American in Liverpool to 14th January, including cotton at sea and on shipboard compares (in 1,000's):—

1928.	*1927.*	*1926.*	*1925.*
751	1,261	829	970

These figures show how much less than normal has been imported and the effect on Liverpool Stock.

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COCOA.—In mid-January, West African was firmer on spot with a decidedly better market for futures. Gold Coast exports in December were 34,585 tons as against 46,810 tons in 1926. On 10th January, Trinidad on the spot was in slow demand, and valued at 70*s.* to 75*s.* for ordinary plantation to fine estates; to arrive was quoted at 67*s.* *f.o.b.* (good mark), 65*s.* 6*d.* *f.o.b.* (no mark). A small business was done in Grenada at 68*s.* to 70*s.* West Indian quotations, 31st January were, Trinidad L.L.T. per cwt. 72*s.* to 76*s.*; Grenada L.L.T. 69*s.* to 70*s.*

COFFEE.—Brazil is dearer. In five weeks Rio rose from 21·4 to 23·7 dollars per bag, and higher grade Santos 4 is up from 28 to 31·0. No material changes in prices are reported in London, but the tone is encouraging for all types. In 1927, 272,968 bags were offered in public auction, made up as follows, Costa Rica, 145,636 and 1,211 new crop; Kenya, 92,946; Tanganyika, 20,872; Toro, 1,564; Uganda, 9,100; Uganda Robusta, 2,850.

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TEA.—Ordinary wholesale prices (Ceylon average 20·08*d.* Indian average 17·71*d.*, Java average 15·10*d.*) were substantially reduced to start 1928 with good demand. London stocks 2nd January were 213,024,766 lb. of which total the chief items were 149,082,199 lb., black Indian, 33,666,008 lb., black Ceylon 16,154,380 lb., Dutch East Indies, 13,600,000 lb., Chinese (much of it for re-exportation) and 121,000 green tea other than Chinese.

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RUBBER.—On 12th January, E.P. spot crêpe stood at 1*s.* 7⅜*d.*, March 1*s.* 8⅛*d.* down to 1*s.* 7⅝*d.*, April-June monthly delivery sold at 1*s.* 8½*d.*, down to 1*s.* 8*d.*, July-September from 1*s.* 8⅞*d.* down to 1*s.* 8⅜*d.* per lb.

The Thames floods caused a restriction in business and it became impossible to deal in spot rubber without guarantee that it was undamaged. The Ford Motor Co., is taking back its employees and expects to turn out 1,000 cars a day. The low prices for new models, both Ford and others is expected to lend to heavy buying of cars and a greater demand for rubber.

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COPRA.—In mid-January, there was no special demand for Copra, France was a fair buyer of kiln dried. West Indian was quoted at £28 5*s.* per ton *c.i.f.* on 31st January.

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OILS, &C.—*Oilcake*: June sales include soya bean cake at 11*s.* 6*d.* per cwt., decorticated cotton seed meal at 12*s.* and arachis cake at 10*s.* 9*d.* per cwt. *Seedoils*: Linseed oil, rapeseed oil, coconut oil have been in greater demand, but olive, cotton seed and soya bean oils have not yet fairly started on 1928 trade. *Palm Kernels* have improved by 5*s.* since the new year. *Ground-nuts* (arachis) is a rising market, their fattening value is becoming more and more recognised.

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MISCELLANEOUS.—The West Indian, Central American, and Brazilian Monthly Market Report of Messrs. Lewis Peat, Ltd., gives the following prices of January. St. Vincent *Arrowroot* 3¾*d.* to 6½*d.* per lb.; Jamaica *Ginger* common to good bold 55*s.* to 85*s.* per cwt; Barbados *Tamarinds*, 20*s.* per cwt.; Demerara and West Indies *Isinglass* lump dark to good pale, 7*d.* to 1*s.*; Jamaica *beeswax* dark to good pale £8 10*s.* per cwt.